Astro.

stw
L
01
2
11
.2

Scientific and Technical Aerospace Reports

ROOM USE ONLY FEB 9 1973

THE UNIVERSITY OF MICHIGAN
FEB 1
ASTRONOMY LIBRARY

A SEMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

JANUARY 23, 1973

VOLUME 11 • NUMBER 2

N73-11001—N73-11997

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

PURCHASE OF *STAR*

The semimonthly issues and the cumulative index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D.C. 20402, United States of America.

Semimonthly issues. . .

Annual subscription rate: $118.00, domestic; $147.50, foreign. Price per single copy: $5.00, domestic; 25% extra for foreign mailing.

Cumulative index issues. . .

Annual subscription rate: $37.50, domestic; $47.00, foreign. Price per single copy varies according to the number of pages.

Domestic subscription rates. . .

Apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

Foreign subscription rates. . .

Apply to Argentina, Brazil, French Guiana, Guyana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

PUBLISHED BY:
UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
SCIENTIFIC AND TECHNICAL INFORMATION OFFICE
Scientific and Technical Aerospace Reports, Volume 11, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Informatics Tisco, Inc.

The Administrator of the National Aeronautics and Space Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through April 1, 1974.

INTRODUCTION

A COMPREHENSIVE INFORMATION SERVICE

The National Aeronautics and Space Administration makes the results of worldwide research and development activities in aeronautics, space, and supporting disciplines promptly available to participants in its programs. NASA's scientific and technical information system now contains nearly a million documents, which are abstracted, indexed, and obtainable through retrieval and dissemination services. These services, which include this abstract journal, *Scientific and Technical Aerospace Reports (STAR)*, are described in a bulletin, *The NASA Scientific and Technical Information System . . . and How to Use It*, available at no charge from the NASA Scientific and Technical Information Facility, P.O. Box 33, College Park, Maryland 20740.

STAR—A REPORT ABSTRACTING SERVICE

STAR is a comprehensive abstracting and indexing journal covering current worldwide *report* literature on the science and technology of space and aeronautics. Publications abstracted in *STAR* include scientific and technical reports issued by NASA and its contractors, other U.S. Government agencies, corporations, universities, and research organizations throughout the world. Pertinent theses, translations, NASA-owned patents and patent applications, and other separate documents are also abstracted. Citations and abstracts in *STAR* are grouped in 34 subject categories, although accession numbers run in unbroken sequence through the *STAR* issues, without regard to category assignment.

Certain publications abstracted in *STAR* are given analytic treatment, with citations and abstracts of daughter items following immediately after the parent document. When the subject content of a daughter differs from that of its parent, a cross-reference citation is printed at the end of the category to which the daughter would normally have been assigned.

Five indexes are included in each issue: subject, personal author, corporate source, contract number, and report/accession number. Cumulative index volumes are published semiannually and annually.

STAR, issued on the 8th and 23rd of each month, is available to the public on subscription from the Superintendent of Documents, U.S. Government Printing Office, as noted on the inside cover. *STAR* is sent without charge to qualified organizations registered with NASA as described in the paragraph *Eligibility and Registration for NASA Information Products and Services*.

ABSTRACTS OF NONREPORT LITERATURE

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts (IAA)* provides parallel coverage of scientific and trade journals, books, and conference papers in the same subject areas as *STAR*. *STAR* and *IAA* are categorized and abstracted in basically identical ways, and documents in both are indexed by terms from the *NASA Thesaurus*. Both journals appear twice monthly, *IAA* being issued on the 1st and 15th of each month.

IAA is available on subscription from the American Institute of Aeronautics and Astronautics, Technical Information Service, 750 Third Avenue, New York, NY 10017, at the following annual rates:

Semimonthly issues: United States and possessions, $110 postpaid; foreign countries, $125 postpaid.

Cumulated index volumes. United States and possessions, $75 postpaid; foreign countries, $90 postpaid.

ANNOUNCEMENT OF NASA PUBLICATIONS IN STAR

Scientific and technical reports produced by NASA and its contractors and grantees, or in conjunction with other Government agencies, and other selected documents released by NASA are identified by an asterisk (*) following the accession numbers (e.g., N73-10205*). Prior to their announcement in *STAR*, these NASA publications are assigned a specific NASA report number, which is shown on the last line of the *STAR* citation. The nature of NASA publications is specified by the report number series, identified by a prefix to the report number: TR-R, TN-D, TM-X, TT-F, CR, or SP. These series refer respectively to NASA Technical Reports, which contain significant and complete contributions to scientific and technical knowledge; Technical Notes, reports of similar quality but lesser scope; Technical Memorandums, reports containing preliminary data or of specialized utility; Technical Translations, information published in a foreign language and considered to merit NASA distribution in English; Contractor Reports, information generated under NASA-sponsored contracts, grants, or interagency agreements; and Special Publications, which include conference proceedings, monographs, data compilations, sourcebooks, special bibliographies, and other publications derived from or of value to NASA activities. Reports in these series that are printed by NASA are often referred to as "low-numbered" or "low series" publications, because the report number is always below 50,000 (8,000 for Technical Translations). Some TM-X and CR reports are numbered above 50,000. These, and TT-F translations above 8,000, are referred to as "high-numbered" or "high series" publications, and are generally available only in microfiche[1] or facsimile reproductions.

DISTRIBUTION OF NASA PUBLICATIONS

NASA distributes its publications to qualified recipients who have registered as described in the next paragraph. (Public availability of NASA reports and other publications announced in *STAR* is discussed separately in this Introduction.) Automatic distribution of low series NASA reports can be made in either paper (printed) copy or microfiche. High series NASA reports are given automatic distribution only as microfiche. The automatic distribution of a NASA report, in paper copy and/or microfiche, is made under the same subject category in which it is announced in *STAR*. A printed low series report usually is disseminated four to six weeks prior to its announcement in *STAR*. Microfiche of both low and high series reports are disseminated concurrently with *STAR* announcement. Automatic distribution of NASA documents is supplemented by a secondary request service, usually for microfiche copy only, which NASA may provide to qualified registrants.

ELIGIBILITY AND REGISTRATION FOR NASA INFORMATION PRODUCTS AND SERVICES

A variety of services, in addition to the distribution of NASA scientific and technical reports and of *STAR* and its cumulative indexes, is available to organizations of the following types that have registered with NASA to receive specific services or products:

1. NASA offices, research centers, contractors, subcontractors, grantees, and consultants;
2. Other U.S. Government agencies and their contractors;
3. Libraries in the United States that have arrangements with NASA to maintain collec-

(1) A microfiche is a transparent sheet of film, 105 by 148 mm in size, containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 24:1 reduction).

tions of NASA documents for public reference;

4. Other organizations in the United States having a need for NASA documents in work related to aeronautics and space research;
5. Organizations abroad that have established reciprocal document exchange arrangements with NASA.

Only the central service points or central points of document acquisition and control within qualified organizations are eligible to register for NASA products and services.

Domestic organizations that may be eligible to receive various classes of NASA publications and services should address their requests for registration or for further information to:

NASA Scientific and Technical Information Facility
Attn.: Registration Activity
P.O. Box 33
College Park, MD 20740

Organizations abroad should direct requests to the same address, but to the attention of: Foreign Exchange and Acquisitions Branch.

PUBLIC AVAILABILITY OF DOCUMENTS ANNOUNCED IN STAR

The source of documents announced in *STAR* varies, depending upon the organization which has issued a document and the form in which the document can be provided. Those documents that can be obtained on microfiche are indicated in *STAR* by the # symbol following the NASA accession number. All documents for which microfiche can be obtained are also available as facsimile.

Documents that cannot be microfiched but for which one-to-one facsimile can be provided are indicated by a plus (+) instead of the # sign. Documents for which neither the + nor # symbol is shown, and for which no availability other than the issuing activity is given, may present unusual problems of reproducibility. The originator of such a document should be consulted as to its availability.

A source from which a document announced in *STAR* is available to the public is ordinarily given on the last line of the citation. The NASA accession number is sufficient when ordering NASA and NASA-sponsored documents (indicated by an asterisk) from the National Technical Information Service. When ordering non-NASA documents (no asterisk) from the issuing agency or other sources, particularly NTIS, it is essential that additional bibliographic information, including the report number, be given.

The following are the most commonly indicated sources: (Full addresses of these organizations are listed at the end of this introduction.)

Avail: NTIS. Sold by the National Technical Information Service as indicated:

Currently Announced Documents. Facsimile (reproduced on demand) copies are sold for $3.00 plus 25 cents for every 5 pages over 20 pages, effective for all documents having the accession number N72-22991 (the first accession in 1972 *STAR* 14) or higher. The full price is shown in the citation.

Printed NASA Documents. Documents such as NASA Technical Reports, Technical Notes, Special Publications, Contractor Reports, Technical Memorandums (numbered below 50,000), and Technical Translations (below 8,000) are priced at $3.00 for documents of 300 pages or less; $6.00 for those in the 301-600 page range; $9.00 for those having 601-900 pages; and individually priced above 900 pages. Documents available both from the Superintendent of Documents (SOD), Government Printing Office, and from NTIS have the SOD price. All prices are shown in the citation. See page vi for NTIS printed document subscription rates.

Documents Announced Between July 1970 and July 1972. All documents with accession numbers between N70-27805 and N72-22990 are sold at the previously announced standard price, whether printed copy or facsimile is supplied. If "Avail: NTIS" appears in the citation, the document is sold at $3.00. Any other price is shown in the citation.

Documents Announced Prior to July 1970. A surcharge of $3.00 is applied to each document that, as of STAR Issue 14, 1972, is two years old from the time of its announcement, i.e., to all documents with an accession number lower than N70-27805 (the first accession number in Issue 14, 1970, of *STAR*), but not to more recently issued documents. Therefore, documents with older accession numbers of 300 pages or less are priced at a total of $6.00. Since no surcharge is applied to documents with over 300 pages, documents in the 301- to 600-page range are also sold for $6.00 in hard copy, and those in the 601- to 900-page range are sold at $9.00. Those exceeding 900 pages are priced by NTIS on an individual basis, except when priced by SOD. These prices do not change with time.

Microfiche. Microfiche is available from NTIS at a standard price of 95 cents (regardless of age) for those documents identified by the # sign following the accession number (e.g., N73-10242#) and having an NTIS availability shown in the citation. Standing orders for microfiche of (1) the full collection of NTIS-available documents announced in *STAR* with the # symbol, (2) NASA reports only (identified by an asterisk (*)), (3) NASA-accessioned non-NASA reports only (for those who wish to maintain an integrated microfiche file of aerospace documents by the "N" accession number), or (4) any of these classes within one or more *STAR* categories, also may be placed with NTIS at greatly reduced prices per title (e.g. 35 cents) over individual requests. These availabilities apply only to microfiche with the standard 95-cent price; any document with a different cited price must be purchased individually at that price. Inquiries concerning NTIS Selective Categories in Microfiche should be addressed to the Subscription Unit, National Technical Information Service.

Deposit Accounts and Customers Outside U.S. NTIS encourages its customers to open deposit accounts to facilitate the purchase of its documents now that prices vary so greatly.

NTIS customers outside the United States are reminded that they should add the following handling and postage charges to the standard or announced prices: hard (paper) copy, $2.50 each document; microfiche, $1.50 each document. For subscribers outside the United States who receive microfiche through the Selective Categories in Microfiche program, NTIS will add 15 cents for each title shipped.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The price and order number are given following the availability line. (An order received by NTIS for one of these documents will be filled at the SOD price if hard copy is requested. NTIS will also fill microfiche requests, at the standard 95 cent price, for those documents identified by a # symbol.)

Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Documents Room (Room 126), 600 Independence Ave., S.W., Washington, D.C. 20546, or public document rooms located at each of the NASA research centers, the Mississippi Test Facility, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

Avail: NASA Scientific and Technical Information Office. Documents with this availability are usually news releases or informational leaflets available without charge in paper copy.

Avail: AEC Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of U.S. Atomic Energy Commission reports, usually in microfiche form, are listed in *Nuclear Science Abstracts*. Services available from the USAEC and its depositories are described in a booklet, *Science Information Available from the Atomic Energy Commission* (TID-4550), which may be obtained without charge from the USAEC Technical Information Center.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) at $10.00 each and microfilm at $4.00 each regardless of the length of the manuscript. Handling and shipping charges are additional. All requests should cite the author and the Order Number as they appear in the citation.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed in this Introduction. The libraries may be queried concerning the timely availability of specific documents and the possible utilization of local copying services (e.g., color reproduction).

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, California. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.

Avail: National Lending Library, Boston Spa, England. Sold by this organization at the price shown. (If none is given, an inquiry should be addressed to NLL.)

Avail: ZLDI. Sold by the Zentralstelle für Luftfahrtdokumentation und -Information, Munich, Federal Republic of Germany, at the price shown in deutschmarks (DM).

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

Avail: U.S. Patent Office. Sold by Commissioner of Patents, U.S. Patent Office, at the standard price of 50 cents each, postage free. (See discussion of patents and patent applications below.)

Other availabilities: If the publication is available from a source other than the above, the publisher and his address will be displayed entirely on the availability line or in combination with the corporate author line.

EUROPEAN AVAILABILITY OF NASA AND AGARD DOCUMENTS

Facsimile copy or microfiche of NASA and NASA-sponsored documents identified by both the symbols # and * and those AGARD reports that are on microfiche may be purchased from:

ESRO/ELDO Space Documentation Service
European Space Research Organization
114, av. Charles de Gaulle
92-Neuilly-sur-Seine, France

NASA PATENTS AND PATENT APPLICATIONS

Patents and patent applications owned by NASA are announced in *STAR* under appropriate subject categories and are referenced in the *STAR* indexes. In the Report/Accession Number Index, patents are indexed by the NASA Case Number (which appears in lieu of the report number in other indexes), the U.S. Patent Number, the U.S. Patent Application Serial Number, and the U.S. Patent Class. Patent applications for which patents have not yet been issued are indexed by the NASA Case Number and the U.S. Patent Application Serial Number.

NASA *patent application specifications* are sold by the National Technical Information Service at the established unit price of $3.00 for hard copy and 95 cents for microfiche. The NASA

accession number should be used for ordering from NTIS. Printed copies of *patents* (which are not microfiched), are available for purchase at 50 cents per copy from:

Commissioner of Patents
U.S. Patent Office
Washington, DC 20231

When ordering patents, the U.S. Patent Number should be used, and payment must be remitted in advance, preferably by money order or check payable to the Commissioner of Patents. Prepaid purchase coupons for ordering are also available from the Patent Office. The patents and patent applications announced in *STAR* are owned by NASA and are available for royalty-free licensing. Requests for licensing terms and further information should be addressed to:

Assistant General Counsel for Patent Matters/Code GP-1
National Aeronautics and Space Administration
Washington, DC 20546

COSATI SUBJECT CATEGORY CODE

In the citation of each NASA-supported document and of some non-NASA documents is a code (e.g., CSCL 25A) that indicates the subject category assigned to it from the COSATI Subject Category List (first ed. December, 1964) published by the Committee on Scientific and Technical Information of the Federal Council for Science and Technology.

INDEXING VOCABULARY

The authority for the indexing vocabulary used in the subject index of this issue of *STAR* is the *NASA Thesaurus*. The most recent version is the *NASA Thesaurus—Alphabetical Update* (NASA SP-7040), September 1971, which is available from NTIS as accession number N72-15923 for $6.00 in paper copy. The current cross-reference structuring for each term appears in this volume, together with additional approved terms that may be used in indexing documents announced in other issues of *STAR*. NASA SP-7040 supersedes the first two volumes (subject terms A–Z) of the three-volume *Preliminary Edition of the NASA Thesaurus* (NASA SP-7030), December 1967. Volume III of the Preliminary Edition presented the following aids to vocabulary selection of the 1967 terms: hierarchical display of index terms, category terms listing, and permuted index; this has not been updated but may still be useful.

SUBSCRIPTION TO NASA PRINTED DOCUMENTS

The National Technical Information Service offers an annual subscription to printed NASA formal series reports at a per-title price, including handling and postage, of $2.00 domestic, $2.50 foreign. (There are no added charges beyond this for subscribers outside the United States.) About 1,000 titles are printed yearly; all must be subscribed to. Included are NASA Technical Reports, Technical Notes, Special Publications (including those printed by the Government Printing Office), Contractor Reports numbered below CR-50,000, Technical Memorandums numbered below TM-X-50,000, and Technical Translations numbered below TT-F-8000. Excluded are NASA patents, Technology Utilization publications (SP-5000 series), NASA continuing bibliographies (SP-7000 series), and Space Vehicle Design Criteria (SP-8000 series). (Continuing bibliographies can be purchased from NTIS on yearly subscription for specific titles and supplements or on an individual-title basis, while the TU and SVDC publications are sold by NTIS only on an individual report basis.) For additional details on subscriptions, inquiries should be directed to NTIS.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
750 Third Ave.
New York, N.Y. 10017

Commissioner of Patents
U.S. Patent Office
Washington, D.C. 20231

Engineering Sciences Data Unit Ltd
251 259 Regent Street
London W1R 7AD, England

ESRO/ELDO Space Documentation Service
European Space Research Organization
114, av. Charles de Gaulle
92-Neuilly-sur-Seine, France

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Scientific and Technical Information Facility
P.O. Box 33
College Park, Maryland 20740

National Aeronautics and Space Administration
Scientific and Technical Information Office (KSI)
Washington, D.C. 20546

National Lending Library for Science and Technology
Boston Spa, Yorkshire, England

National Technical Information Service
Springfield, Virginia 22151

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, California 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Atomic Energy Commission
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

U.S. Geological Survey
1033 General Services Administration Bldg
Washington, D.C. 20242

U.S. Geological Survey
601 E. Cedar Avenue
Flagstaff, Arizona 86002

U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

U.S. Geological Survey
Bldg. 25, Denver Federal Center
Denver, Colorado 80225

Zentralstelle für Luftfahrtdokumentation und -Information
8 Munchen 86
Postfach 880
Federal Republic of Germany

Volume 11 Number 2 / January 23, 1973

TABLE OF CONTENTS

Subject Categories

Abstracts in the journal are grouped under the following categories:

page

01 Aerodynamics 123
Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 32 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

02 Aircraft 124
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc.; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

03 Auxiliary Systems 128
Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

04 Biosciences 130
Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

05 Biotechnology 135
Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

06 Chemistry 136
Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

07 Communications 139
Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

page

08 Computers 144
Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics.

09 Electronic Equipment 148
Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors, integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

10 Electronics 150
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

11 Facilities, Research and Support 151
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

12 Fluid Mechanics 154
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

13 Geophysics 160
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

14 Instrumentation and Photography 171
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders, transducers; aerial photography; and telescopes and cameras.

15 Machine Elements and Processes 176
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection.

16 Masers 180
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State.

17 Materials, Metallic 184
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

page

18 Materials, Nonmetallic 190
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

19 Mathematics 195
Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

20 Meteorology 204
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

21 Navigation 207
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

22 Nuclear Engineering 209
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

23 Physics, General 211
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation.

24 Physics, Atomic, Molecular, and Nuclear 213
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

25 Physics, Plasma 215
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

26 Physics, Solid-State 218
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

27 Propellants 220
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

28 Propulsion Systems 222
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

29 Space Radiation 224
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics, and 24 Physics, Atomic, Molecular, and Nuclear.

30 Space Sciences 226
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbits and trajectories. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

31 Space Vehicles 232
Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

32 Structural Mechanics 236
Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

33 Thermodynamics and Combustion 241
Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

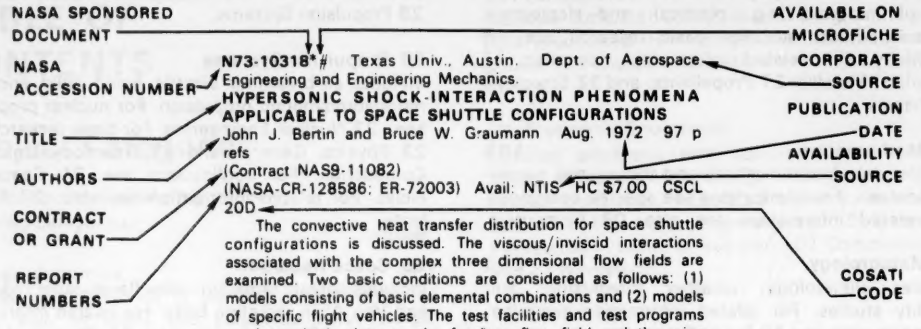
34 General 244
Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

page

SUBJECT INDEX I-1
PERSONAL AUTHOR INDEX I-49
CORPORATE SOURCE INDEX I-55
CONTRACT NUMBER INDEX I-67
REPORT/ACCESSION NUMBER INDEX I-71

TYPICAL CITATIONS AND ABSTRACTS

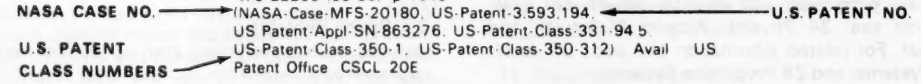
NASA CONTRACTOR REPORT CITATION AND ABSTRACT



N73-10318*# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
HYPERSONIC SHOCK-INTERACTION PHENOMENA APPLICABLE TO SPACE SHUTTLE CONFIGURATIONS
John J. Bertin and Bruce W. Graumann Aug. 1972 97 p refs
(Contract NAS9-11082)
(NASA-CR-128586; ER-72003) Avail: NTIS HC $7.00 CSCL 20D

The convective heat transfer distribution for space shuttle configurations is discussed. The viscous/inviscid interactions associated with the complex three dimensional flow fields are examined. Two basic conditions are considered as follows: (1) models consisting of basic elemental combinations and (2) models of specific flight vehicles. The test facilities and test programs used to obtain data on the fuselage flow field and the wing flow field are described. Author

PATENT CITATION

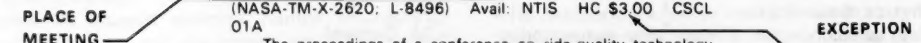


N72-12440* Auburn Research Foundation, Inc., Ala
LASER COOLANT AND ULTRAVIOLET FILTER Patent
John R. Rasquin and Fred R. McDevitt, inventors (to NASA) Issued 13 Jul. 1971 14 p Filed 2 Oct. 1969 Supersedes N70-22250 (08-09, p 1645
(NASA-Case-MFS-20180; US-Patent-3,593,194; US-Patent-Appl-SN-863276; US-Patent-Class-331-94.5; US-Patent-Class-350-1; US-Patent-Class-350-312) Avail: US Patent Office CSCL 20E

PATENT APPLICATION CITATION

N73-10504*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
GRINDING ARRANGEMENT FOR BALL NOSE MILLING CUTTERS Patent Application
Charles F. Burch, inventor (to NASA) Filed 14 Sep. 1972 19 p
(NASA-Case-LAR-10450-1; US-Patent-Appl-SN-289017) Avail: NTIS HC $3.00 CSCL 13I

PRIMARY ANALYTIC CITATION AND ABSTRACT



N73-10012*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SYMPOSIUM ON VEHICLE RIDE QUALITY
Washington Oct. 1972 256 p refs Symp. held at Hampton, Va., 6-7 Jul. 1972
(NASA-TM-X-2620; L-8496) Avail: NTIS HC $3.00 CSCL 01A

The proceedings of a conference on ride-quality technology in the United States is presented. Emphasis is directed toward criteria for passenger air travel. Information on ground and water modes of transportation is included. The subjects involve the present state of knowledge, results of various studies including people, vehicles, and simulators. Mechanisms underlying motion discomfort are examined. For individual titles, see N73-10013 through N73-10025.

SUBSIDIARY ANALYTIC CITATION

N73-10014* Douglas Aircraft Co., Inc., Long Beach, Calif.
AN AIRCRAFT MANUFACTURER'S APPROACH TO RIDEABILITY CRITERIA
R. C. OMassey, H. Leve, and J. G. Gaume *In* NASA. Langley Res. Center Symp. on Vehicle Ride Quality Oct. 1972 p 23-49 refs (For availability see N73-10012 01-02)
CSCL 01A

VOLUME 11 NUMBER 2 / JANUARY 23, 1973

Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N73-11001*+ National Aeronautics and Space Administration, Washington, D.C.
AERONAUTICAL ENGINEERING: A SPECIAL BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 21, AUGUST 1972
Aug. 1972 118 p refs
(NASA-SP-7037(21)) Avail: NTIS HC $3.00 CSCL 01A

This special bibliography lists 362 reports, articles, and other documents introduced into the NASA scientific and technical information system in July 1972. Author

N73-11002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF A SINGLE-STAGE TRANSONIC COMPRESSOR WITH A BLADE-TIP SOLIDITY OF 1.3
Donald C. Urasek and Royce D. Moore Washington Nov. 1972 107 p refs
(NASA-TM-X-2645; E-6763) Avail: NTIS HC $3.00 CSCL 01A

The design and experimental performance of a 50-centimeter-diameter, single stage, axial flow, transonic compressor with a blade tip solidity of 1.3 are presented. Radial surveys were made of the flow conditions for both the rotor and stator. At design speed, peak efficiencies for both rotor and stage were 0.87 and 0.82, respectively, and occurred at an equivalent weight flow of 29.6 kilograms per second (202 kg/sec/sq m of annulus area). At peak efficiency, the total pressure ratios for both rotor and stage were 1.79 and 1.73, respectively. Stall margin for the stage was 17 percent. Author

N73-11003*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ASYMMETRIC LATERAL-DIRECTIONAL CHARACTERISTICS OF POINTED BODIES OF REVOLUTION AT HIGH ANGLES OF ATTACK
Paul L. Coe, Jr., Joseph R. Chambers, and William Letko Washington Nov. 1972 42 p refs
(NASA-TN-D-7095; L-8582) Avail: NTIS HC $3.00 CSCL 01A

A low-speed wind-tunnel investigation was conducted in order to determine the cause of asymmetric yawing moments produced by long pointed fuselage nose shapes at high angles of attack. Force tests were conducted with a cone, tangent-ogive model, and a paraboloid of revolution over a range of Reynolds numbers from 0.15 million to 0.35 million for an angle-of-attack range from 0 deg to 75 deg and an angle-of-sideslip range of plus or minus 30 deg. Tuft and smoke flow-visualization tests were also conducted to aid in the analysis. Large asymmetric yawing moments were obtained for the cone and tangent-ogive body at high angles of attack (of the order of 40 to 60 deg). These large moments were caused by asymmetric shedding of vortex sheets off the long pointed nose. The asymmetric moments could be eliminated by use of symmetrically arranged strikes on the nose. The paraboloid of revolution did not produce a strong asymmetric flow field at high angles of attack and did not exhibit asymmetric moments. Author

N73-11004*# National Aeronautics and Space Administration. Langley Research Centter, Langley Station, Va.
EFFECT OF NOZZLE LATERAL SPACING ON AFTERBODY DRAG AND PERFORMANCE OF TWIN-JET AFTERBODY MODELS WITH CONVERGENT-DIVERGENT NOZZLES AT MACH NUMBERS UP TO 2.2
Odis C. Pendergraft, Jr. and James W. Schmeer Washington Oct. 1972 124 p refs
(NASA-TM-X-2601; L-8338) Avail: NTIS HC $3.00 CSCL 01A

Twin-jet afterbody models were investigated by using two balances to measure the thrust-minus-total drag and the afterbody drag, separately, at static conditions and at Mach numbers up to 2.2 for an angle of attack of 0 deg. Hinged-flap convergent-divergent nozzles were tested at subsonic-cruise- and maximum-afterburning-power settings with a high-pressure air system used to provide jet-total-pressure ratios up to 20. Two nozzle lateral spacings were studied, using afterbodies with similar interfairing shapes but with different longitudinal cross-sectional area distributions. Alternate, blunter, interfairings with different shapes for the two spacings, which produced afterbodies having identical cross-sectional area progressions corresponding to an axisymmetric minimum wave-drag configuration, were also tested. The results indicate that the wide-spaced configurations improved the flow field around the nozzles, thereby reducing drag on the cruise nozzles; however, the increased surface and projected cross-sectional areas caused an increase in afterbody drag. Except for a slight advantage with cruise nozzles at subsonic speeds, the wide-spaced configurations had the higher total drag at all other test conditions. Author

N73-11005*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EXPERIMENTAL AERODYNAMIC CHARACTERISTICS OF 120 DEG INCLUDED-ANGLE CONE WITH ATTACHED AND SEPARATED 20 DEG INCLUDED-ANGLE CONE AT MACH NUMBERS OF 2.36 AND 2.70
Clarence A. Brown, Jr., Charles D. Trescot, Jr., and Celia S. Richardson Washington Oct. 1972 146 p refs
(NASA-TM-X-2603; L-8424) Avail: NTIS HC $3.00 CSCL 01A

An investigation has been conducted in a unitary plan wind tunnel to determine the aerodynamic characteristics of two different size blunt 120 deg-included-angle cones behind a 20 deg-included-angle cone. Forces and moments were measured at Mach numbers of 2.36 and 2.70, longitudinal separation distances from 0 to 3.5 body diameters, lateral (side) distances from 0 to 0.50 body diameter, angles of attack of the 120 deg-included-angle cone from 0.5 deg to 22 deg, angles of attack of the 20 deg-included-angle cone from 0 deg to 180

deg, and a Reynolds number of one million per foot. Large variations in pitching-moment, normal-force, and axial-force coefficients were noted for both Mach numbers and all longitudinal distances for the 120 deg cones in the wake of a 20 deg cone. Author

N73-11006*# Rochester Applied Science Associates, Inc., N.Y.
MAIN ROTOR FREE WAKE GEOMETRY EFFECTS ON BLADE AIR LOADS AND RESPONSE FOR HELICOPTERS IN STEADY MANEUVERS. VOLUME 2: PROGRAM LISTINGS
S. Gene Sadler Washington Sep. 1972 164 p ref
(Contract NAS1-8448)
(NASA-CR-2111; RASA-71-13-Vol-2) Avail: NTIS HC $10.25 CSCL 01B

A mathematical model and computer program was implemented to study the main rotor free wake geometry effects on helicopter rotor blade air loads and response in steady maneuvers. Volume 1 (NASA CR-2110) contains the theoretical formulation and analysis of results. Volume 2 contains the computer program listing. Author

N73-11007*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT AND WIND TUNNEL INVESTIGATION OF THE EFFECTS OF REYNOLDS NUMBER ON INSTALLED BOATTAIL DRAG AT SUBSONIC SPEEDS
Roger Chamberlin and Bernard J. Blaha 1972 16 p refs Proposed for presentation at 11th Aerospace Sci. Meeting and Tech. Display, Washington, D. C., 10-12 Jan. 1973; sponsored by AIAA
(NASA-TM-X-68162; E-7221) Avail: NTIS HC $3.00 CSCL 01A

A flight and wind tunnel investigation was conducted to determine the effects of Reynolds number on the installed boattail drag of an underwing nacelle. Tests were run on a modified F-106B aircraft and 0.05 and 0.22 scale wind tunnel models. Tests were conducted at Mach numbers of 0.6 and 0.9 and over a 16 to 1 range of Reynolds numbers. Highest drag was obtained at intermediate Reynolds numbers corresponding to about the lowest flight values and that of the 0.22 scale model. Significantly lower drag was obtained at both higher and lower Reynolds numbers. Author

N73-11008# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
LOW SPEED AERODYNAMICS OF WINGS, BODIES AND PROPULSION SYSTEMS, 2 Final Progress Report, 10 May 1966 - 9 May 1972
Antonio Ferri and Lu Ting 9 May 1972 9 p refs
(Contract DA-31-124-ARO(D)-464)
(AD-745916; AROD-6291-11-E) Avail: NTIS CSCL 20/4

The problem of the interference of wing and propeller streams was investigated. The assumptions in classical analysis were critically examined. The importance of the nonuniformity and of the finite thickness of the propeller streams on the sectional aerodynamic characteristics of the wing were substantiated. Numerical programs were developed to carry out the two-dimensional sectional analysis of an airfoil in a nonuniform parallel stream. The classical analysis for wing and a single propeller was modified by the use of sectional analysis from the numerical program. For a wing and multipropellers, a new systematic scheme was developed. Author (GRA)

N73-11009# Picatinny Arsenal, Dover, N.J. Engineering Sciences Div.
AERODYNAMIC CHARACTERISTICS AND SUBSONIC FLIGHT PERFORMANCE OF THE SPIN STABILIZED, 4.2 INCH M329A1E1 MORTAR PROJECTILE
R. Kline and W. Gazdayka Jun. 1972 437 p refs
(AD-746977; PA-TR-4300) Avail: NTIS CSCL 19/1

An extensive study of the aerodynamic characteristics of the 4.2 in. M329A1E1 Mortar Projectile has been conducted. A spectrum of yaw levels up to 40 degrees and Mach numbers from 0.55 to 1.025 were covered in the Ballistic Research Laboratories (BRL) Transonic Range Facility. A Magnus wind tunnel test in the Ames 12 ft. Pressure Wind Tunnel involved boom and boattail effects on Magnus as well as static forces from moments. Mach numbers from 0.3 to 0.95 and angles of attack from 0 to 30 degrees (for a Mach number of 0.3) and 0 degrees to 20 degrees (for the higher Mach numbers) were considered. Shells instrumented with yaw sondes were fired at Wallops Island Facility of NASA. The theoretical differential equation of motion then was fitted to the resulting single plane angular motion data. Author (GRA)

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N73-11010 Engineering Sciences Data Unit, London (England).
LONGITUDINAL STABILITY DEFINITIONS AND DISCUSSION OF THE PRINCIPAL TERMS USED
Dec. 1970 7 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-00.00.03) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Definitions of aircraft longitudinal stability are developed to account for effects caused by distortion of the aircraft structure and compressibility effects. The stick fixed and stick free conditions are analyzed for static stability and dynamic stability and dynamic stability response. The theory of static stability is expressed with respect to the neutral point and static margin. Mathematical models are included to clarify the theoretical aspects. Author

N73-11011 Engineering Sciences Data Unit, London (England).
PERFORMANCE ANALYSIS FOR AIRCRAFT WITH TURBOJETS "NON-DIMENSIONAL" GRAPHICAL METHOD RATE OF CLIMB
Jan. 1971 3 p Revised Sponsored by Roy. Aeron. Soc.
(ESDU-RJ1/2-Amend-A; ESDU-RJ1/2-Amend-B) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Curves for determining climb performance of aircraft under standard conditions are presented. A solution to an example problem demonstrating the procedures is included. F.O.S.

N73-11012*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SMALL-SCALE TESTS OF THE MIXER NOZZLE CONCEPT FOR REDUCING BLOWN-FLAP NOISE
Jack H. Goodykoontz, William A. Olsen, and Robert G. Dorsch Washington Nov. 1972 34 p refs
(NASA-TM-X-2638; E-6999) Avail: NTIS HC $3.00 CSCL 01B

Noise tests were conducted using simulated mixer-type nozzles and a small scale model of an externally blown flap, lift augmentation system. The mixer nozzles were simulated with orifice plates. Author

N73-11013*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT INVESTIGATION OF 24 DEG BOATTAIL NOZZLE DRAG AT VARYING SUBSONIC FLIGHT CONDITIONS
Roger Chamberlin Washington Nov. 1972 69 p refs
(NASA-TM-X-2626; E-6846) Avail: NTIS HC $3.00 CSCL 01A

Four configurations of rounded shoulder boattail nozzles were tested on an underwing nacelle mounted on an F-106B aircraft. The effects of various parameters on boattail drag were investigated at Mach numbers of 0.6 and 0.9. The parameters studied were Reynolds number, angle-of-attack, nozzle pressure ratio, nozzle geometry, and nozzle axial location with respect to the wing. These nozzles simulated nonafterburning configurations appropriate for turbofan powered aircraft with supersonic dash capability. Increasing Reynolds number significantly lowered the

boattail drag coefficient of all the nozzles at both M sub 0 = 0.6 and M sub 0 = 0.9. Author

N73-11014*# Whittaker Corp., San Diego, Calif. Research and Development Div.
METAL AIRCRAFT STRUCTURAL ELEMENTS REINFORCED WITH GRAPHITE FILAMENTARY COMPOSITES Final Report
K. R. Berg and J. Ramsey Aug. 1972 85 p refs
(Contract NAS1-10507)
(NASA-CR-112162) Avail: NTIS HC $6.25 CSCL 01C

Strain compatibility equations are used to evaluate the thermal stresses existing when unidirectional graphite composites are bonded to aluminum structures. Based on thermal stresses and optimum placement of the composite, skin-stringer aluminum panels are optimized for minimum weight compression panels with selective composite reinforcement. Composite reinforced skin-stringer panels are thermal cycled to determine the effect of thermal fatigue on structural integrity. Both cycled and uncycled panels are tested in compression and tension. Test results are correlated with predicted loads. Use of filamentary graphite composites is an efficient method of reinforcing metal structures, but care must be taken to minimize thermal stresses. Author

N73-11015*# Kansas Univ./Center for Research, Inc., Lawrence. Engineering Sciences Div.
A SIMULATOR EVALUATION OF THE USE OF SPOILERS ON A LIGHT AIRCRAFT
Carl H. Brainerd and David L. Kohlman Washington NASA Oct. 1972 126 p refs
(Grant NGR-17-002-072)
(NASA-CR-2121) Avail: NTIS HC $3.00 CSCL 01B

A fixed-base flight simulator was used to evaluate wing spoilers for longitudinal flight path control on a modified Cessna Cardinal aircraft. Spoilers which generated the proper pitching moment to maintain aircraft trim C sub L constant could be used as an effective descent rate control. More than 100 simulated ILS approaches were flown by evaluation pilots using both conventional methods and spoiler descent rate control. Three spoiler control schemes were evaluated during the ILS approaches. Using the spoilers for control, instrument approaches could be flown smoothly and precisely with constant airspeed and pitch attitude. While the spoilers could adequately control ILS approaches, a spoiler system with greater authority would be desirable for use in visual approaches. Author

N73-11016*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
LATERAL-DIRECTIONAL AERODYNAMIC CHARACTERISTICS OF LIGHT, TWIN-ENGINE, PROPELLER DRIVEN AIRPLANES
Chester H. Wolowicz and Roxanah B. Yancey Washington Oct. 1972 294 p refs
(NASA-TN-D-6946; H-694) Avail: NTIS HC $3.00 CSCL 01B

Analytical procedures and design data for predicting the lateral-directional static and dynamic stability and control characteristics of light, twin engine, propeller driven airplanes for propeller-off and power-on conditions are reported. Although the consideration of power effects is limited to twin engine airplanes, the propeller-off considerations are applicable to single engine airplanes as well. The procedures are applied to a twin engine, propeller driven, semi-low-wing airplane in the clean configuration through the linear lift range. The calculated derivative characteristics are compared with wind tunnel and flight data. Included in the calculated characteristics are the spiral mode, roll mode, and Dutch roll mode over the speed range of the airplane. Author

N73-11017# National Aviation Facilities Experimental Center, Atlantic City, N.J.
WING LEADING EDGE FUEL TANK IMPACT TESTS Final Report, Jul. 1970 - Jun. 1971
Larry W. Hacker Oct. 1972 56 p
(FAA Proj. 503-101-05X)
(FAA-NA-72-21; FAA-RD-72-83) Avail: NTIS HC $5.00

A typical jet transport wing with integral leading edge fuel tanks was subjected to impacts similar to those which could occur in the vicinity of an airport in an aborted takeoff or an abnormal landing. The problems with the test setup are discussed, also suggestions for improvement are included. The same wing was impacted with several birds to simulate bird strikes. Author

N73-11018*# National Aeronautics and Space Administration Lewis Research Center, Cleveland, Ohio.
ACOUSTIC RESULTS OBTAINED WITH UPPER-SURFACE-BLOWING LIFT AUGMENTATION SYSTEMS
U. VonGlahn, M. Reshotko, and R. G. Dorsch 1972 26 p refs Presented at 84th Meeting of the Acoust. Soc. of Am., Miami Beach, Fla., 28 Nov. - 1 Dec. 1972
(NASA-TM-X-68159; E-7215) Avail: NTIS HC $3.00 CSCL 01B

The noise caused by the interaction of the jet exhaust and a wing was measured under static conditions for several versions of a small-scale STOL engine-over-the-wing configuration. Three basic nozzles were used in the tests; a circular nozzle, a 5:1 aspect ratio slot nozzle and a 10:1 aspect ratio slot nozzle. Various flow attachment devices were included in the study. The wing included a flap that could be positioned for nominal takeoff or approach flap settings. Far field noise data are presented for the flyover mode. The data are discussed in terms of sound power and sound pressure spectra. Implications of extending the small-scale model acoustic data to full-scale aircraft are discussed briefly and indicate a sizeable flyover noise attenuation may be achieved due to shielding by the wing. Author

N73-11019*# LTV Aerospace Corp., Hampton, Va. Hampton Technical Center.
A FUEL CONSERVATION STUDY FOR TRANSPORT AIRCRAFT UTILIZING ADVANCED TECHNOLOGY AND HYDROGEN FUEL
W. Berry, R. Calleson, J. Espil, C. Quartero, and E. Swanson 10 Nov. 1972 33 p refs
(Contract NAS1-10900)
(NASA-CR-112204) Avail: NTIS HC $3.75 CSCL 01B

The conservation of fossil fuels in commercial aviation was investigated. Four categories of aircraft were selected for investigation: (1) conventional, medium range, low take-off gross weight; (2) conventional, long range, high take-off gross weights; (3) large take-off gross weight aircraft that might find future applications using both conventional and advanced technology; and (4) advanced technology aircraft of the future powered with liquid hydrogen fuel. It is concluded that the hydrogen fueled aircraft can perform at reduced size and gross weight the same payload/range mission as conventionally fueled aircraft. F.O.S.

N73-11020# Advisory Group for Aerospace Research and Development, Paris (France).
INTERACTION OF HANDLING QUALITIES, STABILITY, CONTROL AND LOAD ALLEVIATION DEVICES ON STRUCTURAL LOADS Summary Report
Clifford F. Newberry (Boeing Co., Wichita, Kan.) Jul. 1972 17 p refs
(AGARD-R-593) Avail: NTIS HC $3.00

A questionnaire was forwarded to working group members, soliciting answers from their respective countries on techniques used in considering the various interactions. The questionnaire discusses possible effects of load alleviation devices from both static and fatigue loads. Interactions between stability, control, and structural loads when structural modes coalesce with rigid body short period modes are also addressed. The replies received are summarized. The replies generally agree, although differences between manufacturers of fighter and transport aircraft are evident. Author

N73-11021*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WEAR AND RELATED CHARACTERISTICS OF AN AIRCRAFT TIRE DURING BRAKING
John Locke McCarty Washington Nov. 1972 28 p refs
(NASA-TN-D-6963; L-8107) Avail: NTIS HC $3.00 CSCL 11J

Wear and related characteristics of friction and temperature developed during braking of size 22 x 5.5, type aircraft tires are

studied. The testing technique involved gearing the tire to a driving wheel of a ground vehicle to provide operations at constant slip ratios on asphalt, concrete, and slurry-seal surfaces. Data were obtained over the range of slip ratios generally attributed to an aircraft braking system during dry runway operations. The results show that the cumulative tire wear varies linearly with distance traveled and the wear rate increases with increasing slip ratio and is influenced by the runway-surface character. Differences in the wear rates associated with the various surfaces suggest that runways can be rated on the basis of tire wear. The results also show that the friction coefficients developed during fixed-slip-ratio operations are in good agreement with those obtained by other investigators during cyclic braking, in that the dry friction is insensitive to the tire tread temperature is shown to increase with increasing slip ratio and, at the higher ratios, to be greater during braking on asphalt and slurry seal than on concrete. Author

N73-11022# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
SUPERSONIC TURNS WITHOUT SUPERBOOMS
H. S. Ribner Feb. 1972 26 p refs
(Grant AF-AFOSR-1885-70; AF Proj. 9781)
(AD-744859; UTIAS-TN-174; AFOSR-72-0239TR) Avail: NTIS CSCL 01/2

It is shown that focussed booms that arise in turning flight can be suppressed by the simple (although not always practicable) expedient of slowing down the aircraft. The correct deceleration will eliminate the local curvature of the wave front responsible for the focussing. Specifically, the tangential deceleration resolved along the normal to the wave front is adjusted to cancel out the centripetal acceleration similarly resolved. Horizontal turns of a prescribed limiting sharpness are not of concern for this suppression technique; their focussed booms will be cut off from reaching the ground by atmospheric refraction. The minimum turn radius for focus cutoff is related herein in a simple fashion to the tabulated width of the sonic boom carpet for rectilinear flight, as a function of Mach number and altitude.
Author (GRA)

N73-11023# General Dynamics/Fort Worth, Tex.
COMPOSITE WING FOR TRANSONIC IMPROVEMENT. VOLUME 2: ADVANCED ANALYSIS EVALUATION
M. E. Waddoups, L. A. McCullers, and J. D. Naberhaus Nov. 1971 176 p refs
(Contract F33615-70-C-1242)
(AD-745129; AFFDL-TR-71-24-Vol-2) Avail: NTIS CSCL 01/3

The program to provide technical support leading to a composite wing for an aircraft transonic improvement program included technology investigations to establish the feasibility of aeroelastic synthesis for composite wing structures. Modifications were made to an existing direct Rayleigh-Ritz anisotropic plate analysis procedure and the resulting procedure was compared with the finite element method for the analysis of wing structures and correlated with experimental data. The results of this investigation and a preliminary formulation of an aeroelastic synthesis procedure are documented in this volume for future systems support reference. Author (GRA)

N73-11024# Lockheed-Georgia Co., Marietta.
IMPLEMENTATION STUDIES FOR A RELIABILITY-BASED STATIC STRENGTH CRITERIA SYSTEM. VOLUME 1: EVALUATION Final Report, Feb. - Nov. 1971
M. C. Campion, L. C. Hanson, and D. S. Morcock Wright-Patterson AFB, Ohio AFFDL Feb. 1972 191 p refs
(Contract F33615-71-C-1129; AF Proj. 1367)
(AD-742260; LGC-SMN-311-Vol-1; AFFDL-TR-71-178-Vol-1) Avail: NTIS CSCL 01/3

The proposed reliability-based static strength criteria system described in AFFDL-TR-67-107, Volumes I-III, was reviewed to determine the data requirements and availability, the implications of such an approach on the structural design process, methods by which implementation can be achieved without discontinuity, and necessary changes to specification and handbooks. Volume I describes the studies made using data for the C-141 cargo transport. Author (GRA)

N73-11025# Lockheed-Georgia Co., Marietta.
IMPLEMENTATION STUDIES FOR A RELIABILITY-BASED STATIC STRENGTH CRITERIA SYSTEM. VOLUME 2: IMPLEMENTATION Final Report, Feb. - Nov. 1971
M. C. Campion, W. D. Campbell, and J. W. Chapman Wright-Patterson AFB, Ohio AFFDL Feb. 1972 244 p refs
(Contract F33615-71-C-1129; AF Proj. 1367)
(AD-742261; LGC-SMN-311-Vol-2; AFFDL-TR-71-178-Vol-2) Avail: NTIS CSCL 01/3

The proposed reliability-based static strength criteria system described in AFFDL-TR-67-107, Volumes I-III, was reviewed to determine the data requirements and available, the implications of such an approach on the structural design process, methods by which implementation can be achieved without discontinuity, and necessary changes to specification and handbooks. Volume II describes the findings and includes five appendices. The principal conclusions are that insufficient data exists for the imminent implementation, but that studies of the relative reliability of different configurations and components or of different conditions at the same location would provide a short term means of using the system to gain familiarity and confidence. Author (GRA)

N73-11026# ARO, Inc., Arnold Air Force Station, Tenn.
AERODYNAMIC CHARACTERISTICS OF DISK-GAP-BAND PARACHUTES IN THE WAKE OF VIKING ENTRY FOREBODIES AT MACH NUMBERS FROM 0.2 TO 2.6 Final Report, 29 Jun. - 13 Aug. 1971
David E. A. Reichenau AEDC Jul. 1972 37 p ref
(Contract F40600-73-C-0004; ARO Proj. PT1057)
(AD-746291; ARO-PWT-TR-71-192; AEDC-TR-72-78) Avail: NTIS CSCL 01/3

Tests were conducted in wind tunnels to determine the drag and performance characteristics of various disk-gap-band parachute configurations in the wake of a 0.10-scale Viking entry vehicle. The parachutes were also tested behind a small faired body to obtain minimum interference parachute performance characteristics. Increasing the parachute trailing distance and suspension line length increased the parachute drag coefficient at each Mach number. Author (GRA)

N73-11027# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ANALYSIS OF PILOTED WEAPON DELIVERY: F-4C STRAFING WITH STICK-TO-RUDDER INTERCONNECT M.S. Thesis
Thomas Gayle Minnich Jun. 1972 78 p refs
(AD-746000; GGC/EE/72-9) Avail: NTIS CSCL 19/5

An analysis of the pilot-aircraft system is undertaken in order to investigate weapon delivery accuracy of the McDonnell-Douglas F-4 equipment with an experimental stick-to-rudder interconnect. Pilot-vehicle analysis is used to predict the probable tracking errors in a strafing pass. These tracking errors are combined with other pilot-induced errors in a statistical model of weapon delivery in order to predict impact accuracy. The predicted errors were found to exceed those of the standard F-4. The interconnect was redesigned to minimize lateral tracking error. This redesign resulted in reduced lateral tracking error to the noise threshold level. Single-shot, gun-firing pass accuracy of the F-4 with the redesigned interconnect is compared to previously predicted and measured weapon delivery accuracy of the standard F-4. Author (GRA)

N73-11028# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ANALYSIS OF PILOTED WEAPON DELIVERY: F-4C STRAFING WITH HIGH GAIN CONTROL AUGMENTATION M.S. Thesis
David G. Morton Jun. 1972 102 p refs
(AD-746001; GGC/EE/72-10) Avail: NTIS CSCL 01/3

Research was undertaken to analytically predict strafing accuracy of the F-4C aircraft with an experimental high gain control augmentation system incorporated. A model of the pilot-aircraft is formulated which relates pilot tracking performance to overall strafing accuracy. This model permits realistic determination of the essential flight control system dynamic performance characteristics. Projectile impact error is expressed in terms of errors in the task variables which are directly under the pilot's control. Mathematical representations of the aircraft,

the control system dynamics, the turbulence environment, and the human pilot are used to estimate the tracking error contribution. Author (GRA)

N73-11029# Stevens Inst. of Tech., Hoboken, N.J. Dept. of Mechanical Engineering.
THE STRENGTH AND DEFORMATION ANALYSIS OF FLEXIBLE BALLOONS Final Report, 4 Sep. 1968 - 15 Oct. 1971
Harold Alexander Mar. 1972 45 p refs
(Contract F19628-69-C-0069; AF Proj. 7659)
(AD-746308; ME-RT-72004; AFCRL-72-0236) Avail: NTIS CSCL 01/3

The report contains a description of the facilities for and the philosophy of investigation of balloon materials and structures. The major accomplishments include investigations into the mechanical properties of polyethylene balloon films, the development of specifications for qualification and acceptance of polyethylene film for balloon use, evaluation of fiber reinforced films used in high altitude balloons, and evaluation of new plastic films for balloon use. Author (GRA)

N73-11030# Dunlap and Associates, Inc., Santa Monica, Calif.
PREDICTION OF PILOT PERFORMANCE DURING INITIAL CARRIER LANDING QUALIFICATION
Clyde A. Brictson, William J. Burger, and Thomas Gallagher 1972 9 p refs
(Contract N00014-72-C-0041; NR Proj. 196-115)
(AD-746095) Avail: NTIS CSCL 01/2

Several different levels of carrier landing performance criteria based on initial day and night carrier landing qualification trials were developed for inexperienced Navy F4 pilots. The performance criteria were used to estimate the relative proficiency of pilots during landing trials. Selection tests along with basic, advanced flight and RAG training measures were then used to predict the landing performance of each pilot, with emphasis on night carrier recovery. The results indicate that a composite night performance score can be predicted from training measures at an obtained multiple R = .72 (p less than 0.01). Night boarding rate was also predicted at R = .58 (p less than 0.01). Author (GRA)

N73-11031# Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.
ROLLING RESISTANCE AND CARCASS LIFE OF TIRES OPERATING AT HIGH DEFLECTIONS
Peters Skele Feb. 1972 49 p
(AF Proj. 5212)
(AD-746304; AFFDL-TR-70-138) Avail: NTIS CSCL 01/3

The purpose of the study was to determine the effects of tire deflection on rolling resistance and tire life. The tests were conducted on a standard 84-inch diameter aircraft tire dynamometer. Some qualitative effects of deflection were determined. The rolling resistance of a pneumatic tire subjected to a load acting through the wheel axis and normal to the contact patch plane is a function of velocity, deflection, and carcass temperature. When the load and carcass temperature are held constant, rolling resistance increases with increasing deflection and increasing velocity. For a constant deflection and carcass temperature, rolling resistance decreases with increasing inflation pressure. Experimental data indicate that increasing carcass temperature while maintaining a constant deflection results in decreasing rolling resistance. Author (GRA)

N73-11032# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
An-2 AIRCRAFT
I. V. Radchenko, V. P. Kramchaninov, and V. P. Dubrinskii 14 Apr. 1972 657 p Transl. into ENGLISH of the book "Samolet AN-2" Moscow, Izd-vo Transport, 1969 p 1-440
(FTD Proj. 20906391A)
(AD-746791; FTD-MT-24-36-71) Avail: NTIS CSCL 01/3

The book contains the basic flight characteristics and specifications of the An-2 aircraft and its modifications: An-2V, An-2P and An-2M. Considerable space is allotted to the questions of flight operations of the aircraft and its equipment. The description of the construction of units of the aircraft, its systems and special equipment is given as applies to aircraft of the latest production. Author (GRA)

N73-11033# Battelle Memorial Inst., Columbus, Ohio.
FATIGUE CRACK PROPAGATION IN D6AC STEEL PLATE FOR SEVERAL FLIGHT LOADING PROFILES IN DRY AIR AND JP-4 FUEL ENVIRONMENTS Final Report, Feb. - Oct. 1971
Charles E. Feddersen Wright-Patterson AFB, Ohio AFML 28 Jan. 1972 82 p refs
(Contract F33615-71-C-1054)
(AD-746343; AFML-TR-72-20) Avail: NTIS CSCL 01/3

The objective of this experimental program was to obtain an independent evaluation of the fatigue-crack propagation characteristics of D6AC steel for the F-111 aircraft under specific flight loading spectra. The program also included selected studies of constant amplitude fatigue-crack propagation and crack growth retardation under the influence of single overloads. It was determined that fatigue crack propagation specimens evaluated under spectra with peak loads exceeding one-half of the tensile yield strength of the material sustained significantly longer lifetime than under spectra wherein the peak loads were significantly below this stress level. Although the observations were limited, an effect of maximum cyclic stress on constant amplitude crack growth rates was apparent. In the crack growth retardation studies, it was observed that the overload ratio plays a direct role, and the maximum cyclic stress level an inverse role, in delaying crack growth. Author (GRA)

N73-11034# Navy Fleet Material Support Office, Mechanicsburg, Pa. Operations Analysis Dept.
THE 3M AVIATION USAGE RATE SYSTEM USER'S MANUAL
J. W. Sari and Samuel W. Fisher 3 Aug. 1972 49 p ref
(AD-746482) Avail: NTIS CSCL 15/5

Usage rates for aviation items are a basic input to the computation of the range and depth of spare parts carried in support of deployed aircraft. The 3M Aviation Usage Rate System was developed to provide these rates. Following an extensive evaluation, the Aviation Supply Office recently implemented this system to serve as the primary source of data for updating aviation equipment support requirements. This user's manual describes the operation of this usage rate system and its application in the aviation allowance function. Author (GRA)

N73-11035# Naval Air Development Center, Warminster, Pa. Aero Structures Dept.
SURVEY OF FLIGHT LOAD PARAMETERS OF SERVICE AIRCRAFT Summary Report
David J. Rhoads 31 Dec. 1971 219 p refs
(AD-747285; NADC-ST-7001; Rept-8) Avail: NTIS CSCL 01/3

Maneuver data (normal acceleration, airspeed, and altitude) from six models of Naval aircraft for 5130.54 flight hours are presented in the report in the form of frequency curves, histograms, and correlation tables for selected combinations of the measured parameters. Author (GRA)

N73-11036# Boeing Co., Morton, Pa. Vertol Div.
DEVELOPMENT OF COMPOSITE TECHNOLOGY FOR DYNAMIC COMPONENT APPLICATION Final Report
Robert L. Pinckney and H. L. Fritzsche Jun. 1972 97 p refs
(Contract DAAG46-70-C-0006)
(AD-747337; D210-10480-1; AMMRC-CTR-72-9) Avail: NTIS CSCL 01/3

Composite materials were used in the fabrication of a CH-47 pitch link (a heavily loaded tension-compression member in the dynamic flight control system). A dual-load-path structure was designed. HT graphite was selected for the primary load member, S-901 glass for the secondary member, and high-tensile carbon-steel wire for the hoop windings in the metal end-fittings. Semiautomatic production techniques were evaluated and refined during fabrication of the two specimen pitch links as a means of reducing the cost of the components. Author (GRA)

N73-11037# Walter Kidde and Co., Inc., Belleville, N.J.
US ARMY AIRCRAFT IN-FLIGHT FIRE DETECTION AND AUTOMATIC SUPPRESSION SYSTEMS Final Report
Mathew DeRouville and Roger B. Jones Jul. 1972 107 p refs
(Contract DAAJ02-70-C-0056; DA Proj. 1F1-62205-A-529)

(AD-746630; USAAMRDL-TR-72-27) Avail: NTIS CSCL 13/12

In-flight fire reports at U.S. Army Materiel System Analysis Agency (combat) and U.S. Army Agency for Aviation Safety (noncombat) for UH-1, AH-1 and CH-47 helicopters were studied to determine the cause and location of helicopter compartment fires. Two Army helicopter operating bases were visited for firsthand information. The in-flight fires were divided into groups, and from the number of incidents in each group, a priority was established to secure the most effective results toward development of automatic suppression systems. A survey was made of fire detectors and methods of extinguishment and suppression, and the characteristics of such systems were evaluated for possible use in the fire suppression systems. System concepts were developed and methods of detection and extinguishment/suppression were selected as most suited for integration into the aircraft system. Design criteria for the various concepts were developed and recommendations made as to systems to be used in the test phase. Simulations of engine, oil cooler, and electronics compartments were fabricated, and selected systems were tested. Author (GRA)

N73-11038# Dynamic Science, Phoenix, Ariz.
THE DESIGN, DEVELOPMENT, AND TESTING OF AN AIRCREW RESTRAINT SYSTEM FOR ARMY AIRCRAFT Final Report
Gregory Kourovklis, John J. Glancy, and Stanley P. Desjardins Jun. 1972 250 p refs
(Contract DAAJ05-70-C-0065; DA Proj. 1F1-62205-A-529)
(AD-746631; USAAMRDL-TR-72-26; Rept-1680-72-5) Avail: NTIS CSCL 13/12

The purposes of this study were to design, test, and optimize an aircrew restraint system for a forward-facing, nonejection seat for Army aircraft based on the criteria contained in Chapter 4 of USAAMRDL Technical Report 71-122, Crash Survival Design Guide, October 1971, and to prepare a proposed draft Military Specification. A literature search was conducted to determine the state-of-the-art in restraint system development and injury potential prediction technology. The dynamics of an occupant restrained in an integrally armored crew seat were analyzed to establish restraint system performance trends as a function of pertinent variables. Author (GRA)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines, hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; Nuclear Engineering; and 28 Propulsion Systems.

N73-11039*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
GRAVITATIONAL EFFECTS ON ELECTROCHEMICAL BATTERIES
Robert E. Meredith (Oregon State Univ.), Gordon L. Juvinall, and A. A. Uchiyama 15 Nov. 1972 76 p refs
(Contract NAS7-100)
(NASA-CR-129091; JPL-TR-32-1570) Avail: NTIS HC $6.00 CSCL 10C

The existing work on gravitational effects on electrochemical batteries is summarized, certain conclusions are drawn, and recommendations are made for future activities in this field. The effects of sustained high-G environments on cycle silver-zinc and nickel-cadmium cells have been evaluated over four complete cycles in the region of 10 to 75 G. Although no effects on high current discharge performances or on ampere-hour capacity were noted, severe zinc migration and sloughing of active material from the zinc electrode were observed. This latter effect constitutes real damage, and over a long period of time would result in loss of capacity. It is recommended that a zero-G battery experiment be implemented. Both an orbiting satellite and a sounding rocket approach are being considered. Author

N73-11040*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CHARACTERIZATION OF THE 20-Ah NICKEL-CADMIUM CELL USED FOR ENERGY STORAGE ON THE ORBITING ASTRONOMICAL OBSERVATORY
Floyd E. Ford Sep. 1972 29 p refs
(NASA-TM-X-66093; X-761-72-330) Avail: NTIS HC $3.50 CSCL 10C

Tests were conducted on 20-Ah sealed nickel cadmium cells to evaluate initial and long-term performance at various charge rates, temperatures and voltage-control levels. An average ampere-hour recharge of 103 percent per orbit at 13 C was able to maintain cell capacity; required watt-hour recharge on an orbital basis was 8 to 10 percent greater than required ampere-hour recharge. Cells exhibited an early life burn-in characteristic. A discharge after periods of repetitive cycling yielded two voltage plateaus which were temporarily eliminated by the discharge. Author

N73-11041*# Ion Physics Corp., Burlington, Mass.
DEVELOPMENT OF GaAs SOLAR CELLS Quarterly Technical Report, 31 Jan. - 30 Apr. 1972
Philip J. McNally May 1972 30 p Prepared for JPL
(Contracts NAS7-100; JPL-953270)
(NASA-CR-129214; QTR-2) Avail: NTIS HC $3.50 CSCL 10A

This is the second quarterly technical report on a program, the goal of which is to achieve high efficiency GaAs solar cells. Analysis was concerned with providing design information for use in experimentally determining optimum solar cell process parameters. The first quarterly report contained the results of those design calculations. Using those results as a guide, experimental work was initiated to determine optimum cell process parameters. The initial results on this phase of the program are reported. Author

N73-11042*# Ion Physics Corp., Burlington, Mass.
DEVELOPMENT OF GaAs SOLAR CELLS Quarterly Technical Report, 1 May - 31 Jul. 1972
31 Jul. 1972 21 p refs Prepared for JPL
(Contracts NAS7-100; JPL-953270)
(NASA-CR-129199; QTR-3) Avail: NTIS HC $3.25 CSCL 10A

Solar cells and mesa diodes were fabricated by the implantation of zinc or beryllium ions into n-type gallium arsenide. Annealing temperatures above 750 C (zinc) or 650 C (beryllium) were found to produce 50% to 100% activation of the implanted ions. Junction depths of about 0.4 micron were produced by 600 keV zinc implants or 70 keV beryllium implants. P-layer sheet resistance was about 150 ohms for 2 x 10 to the 15th power cm/2 zinc or 1 x 10 to the 15th power cm/2 beryllium implants. This is sufficiently low for efficient solar cell fabrication. Contacting procedures were improved to yield reproducibly adherent, low resistance front and back contacts. Author

N73-11043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ASDTIC: A FEEDBACK CONTROL INNOVATION
Vincent R. Lalli and A. D. Schoenfeld 1972 20 p refs Presented at 8th Propulsion Joint Specialists Conf., New Orleans, 29 Nov. - 1 Dec. 1972; sponsored by AIAA and SAE
(NASA-TM-X-68153; E-7184) Avail: NTIS HC $3.00 CSCL 10B

The ASDTIC (Analog Signal to Discrete Time Interval Converter) control subsystem provides precise output control of high performance aerospace power supplies. The key to ASDTIC operation is that it stably controls output by sensing output energy change as well as output magnitude. The ASDTIC control subsystem and control module were developed to improve power supply performance during static and dynamic input voltage and output load variations, to reduce output voltage or current regulation due to component variations or aging, to maintain a stable feedback control with variations in the loop gain or loop time constants, and to standardize the feedback control subsystem for power conditioning equipment. Author

N73-11044*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT OF LITHIUM DOPED RADIATION RESISTENT SOLAR CELLS
Paul A. Berman 15 Nov. 1972 25 p refs
(Contract NAS7-100)

(NASA-CR-129183; JPL-TR-32-1574) Avail: NTIS HC $3.25 CSCL 10C

Lithium-doped solar cells have been fabricated with initial lot efficiencies averaging 11.9 percent in an air mass zero (AMO) solar simulator and a maximum observed efficiency of 12.8 percent. The best lithium-doped solar cells are approximately 15 percent higher in maximum power than state-of-the-art n-p cells after moderate to high fluences of 1-MeV electrons and after 6-7 months exposure to low flux irradiation by a Sr-90 beta source, which approximates the electron spectrum and flux associated with near Earth space. Furthermore, lithium-doped cells were found to degrade at a rate only one tenth that of state-of-the-art n-p cells under 28-MeV electron irradiation. Excellent progress has been made in quantitative predictions of post-irradiation current-voltage characteristics as a function of cell design by means of capacitance-voltage measurements, and this information has been used to achieve further improvements in lithium-doped cell design. Author

N73-11045*# Radio Corp. of America, Princeton, N.J. Astro Electronics Div.

THE REVISED SOLAR ARRAY SYNTHESIS COMPUTER PROGRAM Final Report

1 Feb. 1970 45 p refs

(Contract NAS5-11669)

(NASA-CR-130109) Avail: NTIS HC $4.25 CSCL 10A

The Revised Solar Array Synthesis Computer Program is described. It is a general-purpose program which computes solar array output characteristics while accounting for the effects of temperature, incidence angle, charged-particle irradiation, and other degradation effects on various solar array configurations in either circular or elliptical orbits. Array configurations may consist of up to 75 solar cell panels arranged in any series-parallel combination not exceeding three series-connected panels in a parallel string and no more than 25 parallel strings in an array. Up to 100 separate solar array current-voltage characteristics, corresponding to 100 equal-time increments during the sunlight illuminated portion of an orbit or any 100 user-specified combinations of incidence angle and temperature, can be computed and printed out during one complete computer execution. Individual panel incidence angles may be computed and printed out at the user's option. Author

N73-11046# Army Foreign Science and Technology Center, Charlottesville, Va.

PROTECTIVE COATINGS FOR SOLAR BATTERIES

M. M. Koltun, I. I. Gribelyuk, N. M. Anufrieva, G. N. Groshkova, and M. V. Tatarenkova 28 Dec. 1971 8 p refs Transl. into ENGLISH from Geliotekh. (USSR), no. 5, 1970 p 52-55

(AD-746325; FSTC-HT-23-681-72) Avail: NTIS CSCL 10/2

The characteristics of solar power installations are determined to a significant degree by the extent to which the working surface is protected from atmospheric effects. Humidity, wind-borne sand, sharp temperature changes and solar radiations damage the sensitive layer of the photoelements and lead to contact corrosion, which affects the efficiency of solar batteries. To reduce the working temperature of the photoelements, two types of coatings were tested: namely, varnishes and inorganic glasses attached to the photoelements by elastic substances. Polysiloxene silazane, alkyd acrylic, styrene acrilic, and polyester modified polysiloxane paints were all found incapable of sustaining the protection of a vacuum deposited sensitive layer on solar elements. Only inorganic glasses attached with a catalytic action rubber-like compound were capable of protecting these sensitive coatings. GRA

N73-11047# Thermo Electron Corp., Waltham, Mass.

DEVELOPMENT OF FLAME-HEATED THERMIONIC DIODES Final Report, 30 Oct. 1961 - 1 Apr. 1972

Lazaros J. Lazaridis, Peter G. Pantazelos, and Paul K. Shefsiek May 1972 228 p refs

(Contract DA-36-039-SC-87341(E); DA Proj. 1T6-62705-A-053)

(AD-746255; TE4017-124-72; ECOM-87341-F) Avail: NTIS CSCL 10/2

The report summarizes the work performed by Thermo Electron Corporation to develop a gasoline-fired thermionic power supply. The work is divided into three phases: (1) The development of a gasoline burner capable of providing the high temperature and high heat fluxes required by the thermionic converters. (2) The development of a thermionic converter with the required power output, efficiency, weight and life. (3) The design of a power supply using the above two components and including power conditioning, controls and packaging. Author (GRA)

N73-11048# Philco-Ford Corp., Palo Alto, Calif. Western Development Labs. Div.

REAL TIME EFFECTS OF SPACE AND NUCLEAR ENVIRONMENTS ON LITHIUM-DOPED CELLS Final Report

Donald C. Briggs, Howard E. Pollard, and Darryl G. Peterson Jul. 1972 174 p refs

(Contract F33615-70-C-1207; AF Proj. 3145)

(AD-745992; WDL-TR-5028; AFAPL-TR-72-44) Avail: NTIS CSCL 10/2

Lithium-doped silicon solar cells were irradiated at a real-time rate, with a strontium-90 radioisotope simulating the trapped electron environment. The irradiation was performed for a one-year period in a vacuum chamber. Four types of lithium cells and one type of conventional N/P cell were controlled to temperatures typical of normal satellite operational conditions. At the six-month point, the cells were exposed to a pulsed neutron environment simulating a nuclear weapon detonation. The experiment was successful in providing high quality data characterizing the comparative performance of several solar cell types. Conventional N/P cells outperformed lithium cells in the non-weapon environment and are recommended for all missions without hardening requirements. Author (GRA)

N73-11049# Naval Civil Engineering Lab., Port Hueneme, Calif.

THREE PHASE POWER DISTURBANCE MONITOR

M. N. Smith Jun. 1972 19 p

(AD-746169; NCEL-TN-1240) Avail: NTIS CSCL 10/2

The report describes a newly developed three-phase power disturbance monitor which consists of an overvoltage sensor counter, undervoltage sensor counter, low threshold pulse transient sensor counter, high threshold sensor counter and an over-under frequency sensor counter. The monitor will simultaneously monitor voltage or frequency variations and pulse transients of either positive or negative polarity on all phases of a 120/208, three-phase, 50-60 hertz power distribution circuit.

Author (GRA)

N73-11050# Army Foreign Science and Technology Center, Charlottesville, Va.

CONTEMPORARY STATUS OF STUDIES ON DIRECT CONVERSION OF SOLAR ENERGY TO ELECTRICAL ENERGY

N. S. Lidorenko 28 Jul. 1972 11 p refs Transl. into ENGLISH from Geliotekhnika (Tashkent), no. 6, 1969 p 3-9

(AD-747293; FSTC-HT-23-1429-71) Avail: NTIS CSCL 10/2

Photoelectric, thermoelectric and thermoemission methods of direct conversion of solar energy into electric energy are studied. The article presents a review of modern methods of investigation.

Author (GRA)

N73-11051# Army Foreign Science and Technology Center, Charlottesville, Va.

NEW MANGANESE-ZINC SYSTEM CURRENT SOURCES WITH ALKALINE ELECTROLYTE

F. Kh. Nabyullin, A. M. Buzova, E. M. Gerksik, and I. I. Koval 26 Jun. 1972 10 p Transl. into ENGLISH from Elektrotekhnika (USSR), no. 5, May 1970 p 21-23

(AD-746558; FSTC-HT-23-827-72) Avail: NTIS CSCL 10/3

Data for different sizes of alkaline manganese-zinc cells are analyzed and compared with salt-electrolyte cells.

Author (GRA)

N73-11052# GTE Labs., Inc., Bayside, N.Y.

LITHIUM BATTERY WITH INORGANIC ELECTROLYTE Quarterly Progress Report, 1 Feb. - 30 Apr. 1972

James J. Auborn, Kenneth French, Adam Heller, S. Liberman, and V. Shah Jul. 1972 22 p

(Contract DAAB07-72-C-0060)

(AD-746633; TR-72-845.2; ECOM-0060-2; QPR-2) Avail: NTIS CSCL 10/3

Experimental lithium anode cells with inorganic electrolytes

operable at ambient temperatures as well as at temperatures as low as -40 C were made using the POCl3-SOCl2 solvent system. Using a 1.2 M LiBCl4 solution in the solvent as electrolyte, a conductivity of 0.006/ohm-cm was reached (at 25 C), and a range of solid cathodes was surveyed. The cathode survey covered elements (such as sulfur and metals) metal halides, metal oxides, and metal sulfides, as well as catalytic surfaces over which the solvent is reduced. The best cathodes identified were the sulfur and the catalytic cathodes. Author (GRA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N73-11053 National Lending Library for Science and Technology, Boston Spa (England).
DISORDERS OF THE NERVOUS SYSTEM IN DECOMPRESSION DISEASE
G. A. Akimov 10 Jul. 1972 13 p refs Transl. into ENGLISH from Zh. Nevropat. Psikhatr. (Moscow), v. 69, 1969 p 979-984 (NLL-DRIC-Trans-2788-(3623.66)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

On the basis of a clinical study of 56 cases with neurological symptoms in decompression sickness (caisson disease), the authors distinguished the following varieties: (1) cerebral forms, (2) spinal, (3) neural, and (4) obliterated. In 2 cases which were attributed to the cerebral (with comatose conditions) and spinal forms of decompression sickness, pathomorphological studies were also performed. It was established that the main significance should be connected with circulatory disturbances and the peculiarities of vascularization in the pathogenesis of nervous-system lesions. Author

N73-11054*+ National Aeronautics and Space Administration, Washington, D.C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES, SUPPLEMENT 106, SEPTEMBER 1972
Sep. 1972 107 p refs
(NASA-SP-7011(106)) Avail: NTIS HC $3.00 CSCL 06E

This special bibliography lists 323 reports, articles, and other documents introduced into the NASA scientific and technical information system in August 1972. Author

N73-11055*# General Electric Co., Philadelphia, Pa.
CONVECTIONLESS ELECTROPHORETIC SEPARATION OF BIOLOGICAL PREPARATIONS Final Report, 25 Jun. 1971 - 24 Jun. 1972
R. N. Griffin and L. R. McCreight 24 Jun. 1972 112 p refs (Contract NAS8-27797)
(NASA-CR-123920) Avail: NTIS HC $7.75 CSCL 06A

Free electrophoresis in a zero gravity environment was investigated on the Apollo 14, and 16 flights. The Apollo 16 electrophoresis equipment and experiment are described along with the required ground-based testing. F.O.S.

N73-11056*# Brown Univ., Providence, R.I. Center for Dynamical Systems.
MATHEMATICAL MODELING OF THE GLUCOSE HOMEOSTASIS IN HUMANS
H. T. Banks and Christin A. Carter Jul. 1972 49 p refs (Grant NGL-40-002-015; DA-ARO(D)-31-124-71-G12S2) (NASA-CR-129171; Lecture-Notes-72-1) Avail: NTIS HC $4.50 CSCL 06S

A model of the glucose homeostasis system that allows in vivo validification is examined. A preliminary version of the model is given. E.H.W.

N73-11057# Defence Research Board, Ottawa (Ontario). Aviation Medical Research Unit.
DRB AVIATION MEDICAL RESEARCH UNIT REPORTS. VOLUME 2: 1968-1971
G. Melvill Jones, comp. Aug. 1972 235 p refs Prepared in cooperation with McGill Univ.
(DR-215) Avail: NTIS HC $13.75

Relevant research in the field of sensory motor neurophysiology, in relation to orientation and disorientation in aerospace environments, is reported. Specific information cover the characteristics of mechanical neurological and subjective sensory response of the vestibular system to real movement stimuli, with the intention of describing the basic capabilities of the system and the failure of these capabilities to match the extended movement environment of flight and space. For individual titles, see N73-11058 through N73-11069.

N73-11058 Defence Research Board, Ottawa (Ontario).
THE FUNCTIONAL SIGNIFICANCE OF SEMICIRCULAR CANAL SIZE
G. Melvill Jones *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 1-15 refs Repr. of chapter in "Handbook of Sensory Physiology" v. 6 Berlin, Springer, 1969 (For availability see N73-11057 02-04)
(AMRU-R-69-1)

The influence of four physical dimensions of the semicircular canal on physiological processes is examined. Criteria examined included (1) ratio of viscous forces to inertia, (2) flow patterns generated by normal head movement, (3) very small Reynolds numbers encountered, and (4) damping. E.H.W.

N73-11059 Defence Research Board, Ottawa (Ontario).
CHARACTERISTICS OF NEURAL TRANSMISSION FROM THE SEMICIRCULAR CANAL TO THE VESTIBULAR NUCLEI OF CATS
G. Melvill Jones and J. H. Milsum *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 16-36 refs Repr. from J. Physiol. (London), no. 209, 1970 p 295-316 (For availability see N73-11057 02-04)
(AMRU-R-70-2)

The characteristics of the dynamic response of specifically canal-dependent neural units in cat vestibular nuclei were examined during sinusoidal rotation of the head in decerebrate cats over the narrow frequency range 0.25 to 1.7 Hz. Unit action potential frequencies were averaged on line from extracellular steel micro-electrodes stereotaxically located in the vestibular nuclei through the intact cerebellum. Action potential frequency was approximately in phase with stimulus angular velocity, the mean phase for forty-six units being +11.4 deg (S.E. of the mean + or - 2.2 deg). Correction for a form of dynamic asymmetry reduced this value almost to zero. Directionality was examined in 116 units, of which 62% were ipsilateral (e.g. cells on left side excited by left-going rotational velocity) and 38% contralateral. No significant differences in mean phase or gain were found in the sub-sets of spontaneously active/inactive cells and ipsilateral/contralateral cells. It is inferred that the cell population examined was a functionally homogeneous one in which the neural signal was closely tied to the angular velocity of canal rotation for the narrow band of sinusoidal rotational stimuli here employed. Author

N73-11060 Defence Research Board, Ottawa (Ontario).
DYNAMIC ASYMMETRY IN NEURAL COMPONENTS OF THE VESTIBULAR SYSTEM
J. H. Milsum and G. Melvill Jones *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 37-55 refs Repr. from Ann. N. Y. Acad. Sci., no. 156, 1969 p 851-871 (For availability see N73-11057 02-04)
(AMRU-R-69-2)

An asymmetric form of shaping in the neural response to symmetric sinusoidal rotational stimulation of the semicircular canals was quantitatively examined in 24 decerebrate cats. Asymmetry in the neural response was defined as the ratio of the times from commencement of firing to maximum frequency and from maximum frequency to cessation of firing (skew ratio, Sk). For cells firing through more than half a cycle this characterization was determined from a duration equal to one-half cycle. The results from 141 averaged responses gave an Sk value of 0.84 indicating an overall tendency to development of an asymmetric, or a skewed, response. When responses firing all-round the cycle (32) were separated from those exhibiting threshold cutoff at some point in the cycle (109), respective Sk values of 0.95 and 0.78 were obtained. From these results, it is concluded that the rising phase of action potential frequency

was significantly sharper (steeper) than the falling phase in cutoff responses, but that this was not the case for all-round-firing responses. The asymmetric response was largely independent of stimulus period over the whole range employed. Author

N73-11061 Defence Research Board, Ottawa (Ontario).
RESPONSE OF SEMICIRCULAR CANAL DEPENDENT UNITS IN VESTIBULAR NUCLEI TO ROTATION OF A LINEAR ACCELERATION VECTOR WITHOUT ANGULAR ACCELERATION
A. J. Benson, F. E. Geudry, and G. Melvill Jones *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 56-74 refs Repr. from J. Physiol. (London), no. 210, 1970 p 475-494 (For availability see N73-11057 02-04)
(AMRU-R-70-4)

Discharge frequencies of specifically lateral canal-dependent neural units in the vestibular nuclei of decerebrate cats were recorded in their spontaneous condition and when the animal was exposed to motion which generated a linear centripetal acceleration vector of 4.4 m/sec sq rotating round the head at 0.52 rev/sec. The motion did not include angular acceleration of the animal. Without exception all canal-dependent cells examined (29 cells in 9 cats) were more active during rotation of the vector in the direction of endolymph circulation shown to be excitatory to the individual cells, than during vector rotation in the opposite direction. The average change in discharge frequency due to rotation of the vector was commensurate with the involuntary oculomotor response induced by the same stimulus in the intact animal. The results suggest that the canals can be stimulated by the rotation of an appropriate linear acceleration vector. Author

N73-11062 Defence Research Board, Ottawa (Ontario).
A QUANTITATIVE STUDY OF VESTIBULAR ADAPTATION IN HUMANS
R. Malcolm and G. Melvill Jones *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 75-94 refs Repr. from Acta Oto-Laryngol. (Uppsala), no. 70, 1970 p 126-135 (For availability see N73-11057 02-04)
(AMRU-R-70-1)

A mathematical model for short term adaptation to vestibular stimuli was presented in which the physiological response is driven by a signal proportional to the difference between the peripheral end-organ response (Oc) and a central reference level (R) in such a way that, dR/dt is approximately (Oc - R). From this relation a transfer function is derived relating slow phase angular velocity of resulting nystagmus to the angular velocity of head rotation. The resulting model was tested by comparing its responses to controlled step and ramp angular velocity stimuli with those of human subjects. A close match was obtained in all cases, which strongly supports the view that a significant adaptive effect is at play. The main time constant of the adaptive term was 82 sec (S.E. 6.5) and the mean cupular restoration time constant (T sub c) was 21 sec. It is suggested that previous values quoted fot T sub c represent underestimates of the true value owing to superposition of the adaptive term here described. The adaptive term accounts well for the phenomenon of secondary nystagmus, especially during either strong stimuli or prolonged rotations. Some implications of the findings in relation to clinical and aviation medicine are discussed. Author

N73-11063 Defence Research Board, Ottawa (Ontario).
ORIGIN SIGNIFICANCE AND AMELIORATION OF CORIOLIS ILLUSIONS FROM THE SEMICIRCULAR CANALS: A NON-MATHEMATICAL APPRAISAL
G. Melvill Jones *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 95-110 refs Repr. from Aerospace Med., no. 41, 1970 p 483-490 (For availability see N73-11057 02-04)
(AMRU-R-70-6)

The physical origin of so-called coriolis illusions deriving from semicircular canal stimulation is examined in the functional context of the aerospace environment. It is shown that in the whole-vestibulo-postural system it is not enough to calculate mechanical cross coupling effects in the end-organ. Effects such as optokinetic fixation, the direction of prevailing gravitational field, vestibular adaptation, and habituation may substantially modify reflex and perceptual responses to the sensory message received in the brain stem. Experimental evidence indicates that reflex vestibular stabilisation of the head probably acts to minimise cross coupling effects in man's natural life, and this suggests ways of ameliorating these effects in flight. Author

N73-11064 Defence Research Board, Ottawa (Ontario).
EFFECT OF CHANGES IN ILLUMINATION LEVEL ON ELECTRO-OCULOGRAPHY (EOG)
A. Gonshor and R. Malcolm *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 111-115 refs Repr. from Aerospace Med., no. 42, 1971 p 138-140 (For availability see N73-11057 02-04)
(AMRU-R-71-1)

Changes occur in the corneo-retinal potential of the eye when the level of ambient illumination is altered. These changes can seriously affect electro-oculographic (EOG) records, a technique frequently used for measuring nystagmus. Some EOG calibrations were done on seven human subjects for periods during which the illumination was varied between normal room light, red light, and total darkness. The time dependence of the observed variations was established and seen to be reasonably consistent between all subjects. For purposes of EOG calibration, no difference was found between a red light environment and total darkness. When experiments are to be performed in the dark, or with eyes closed, it is strongly recommended that subjects be dark adapted for at least 50 minutes prior to calibrating and recording eye position. Author

N73-11065 Defence Research Board, Ottawa (Ontario).
A MODEL OF EYE MOVEMENTS INDUCED BY HEAD ROTATION
N. Sugie and G. Melvill Jones *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 116-141 refs Repr. from IEEE, Trans. SSC, SMC-1, 1971 p 251-260 (For availability see N73-11057 02-04)
(AMRU-R-71-3)

It is well known that head rotation will induce eye movements known as rotational nystagmus, the slow phase of which compensates for head rotation fairly well, and the quick phase of which takes place intermittently in the opposite direction to the preceding slow phase. From both frequency and transient responses, it is confirmed that the slow phase velocity is proportional to the output of the semicircular canal, the main transducer of head rotation. The relationship between the canal output and the quick phase is also discussed. A simple model is proposed in which the quick phase and slow phase are separately generated. In cats under controlled ether anaesthesia, it is found that both phases of the rotational nystagmus can be decomposed into primary and secondary components, and a new model of the vestibulo-ocular system is proposed which includes the simultaneous influence of these two components. The model is analyzed to find a condition where the summed effect of primary and secondary components of response constituting the slow phase of rotational ocular nystagmus can be made proportional to the canal output. Many simulation results are presented to demonstrate the validity of the model. Author

N73-11066 Defence Research Board, Ottawa (Ontario).
VESTIBULO-OCULAR RESPONSES IN MAN DURING SLEEP
G. Melvill Jones and N. Sugie *In its* DRB Aviation Med. Res. Unit Rept. Vol. 2: 1968-1971 Aug. 1972 p 142-162 refs Submitted for publication (For availability see N73-11057 02-04)
(AMRU-R-70-3)

The vestibulo-ocular response of human subjects to prolonged oscillatory rotational stimulation was investigated during various stages of sleep and arousal. Five stages of oculomotor response are described: (1) alert and awake but with eyes closed, (2) drowsy or light sleep, (3) deep sleep, (4) wandering eye movement without saccades, and (5) very deep sleep. The effects relative to each stage are given. It is proposed that these effects could be accounted for first by desynchronisation of saccadic burst activity in oculomotor neurones and then by preferential suppressions of the resulting degraded, or smoothed saccadic signal relative to the primary compensatory one. Eventually in deep sleep suppression of both signals would lead to Stage 5. It is shown that appropriate modification of a previously described model of the vestibulo-ocular system of the cat can simulate the major findings on this basis. The Rapid eye movement (REM)

phase of sleep was never observed during the continuous oscillatory stimulus, even though some experiments continued uninterrupted for up to 6 hours. Author

N73-11067 Defence Research Board, Ottawa (Ontario).
ORGANIZATION OF NEURAL CONTROL OF THE VESTIBULO-OCULAR REFLEX ARC
G. Melvill Jones *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 refs Repr. from "The Control of Eye Movements" London, Academic Press, 1971 p 497-518 (For availability see N73-11057 02-04)
(AMRU-R-71-2)

The hydrodynamic response of the vestibulo-ocular reflex arc is examined. Data cover angular velocity of rotational simulation, neural signals, oculomotor response, and influence of saccades on oculomotor response. E.H.W.

N73-11068 Defence Research Board, Ottawa (Ontario).
NEURAL RESPONSE OF THE VESTIBULAR SYSTEM TO TRANSLATIONAL ACCELERATION
G. Melvill Jones and J. H. Milsum *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 183-190 refs Repr. from Proc. of Symp. on Systems Analysis Approach to Neurophysiol. Probl. Brainherd, 1969 p 105-117 (For availability see N73-11057 02-04)
(AMRU-R-69-3)

The sensitivity, trigonometric resolution, and phase of unit responses were investigated in specifically otolith-dependent cells in the vestibular nuclei of cats during sinusoidal linear acceleration. It was concluded that: (1) some units respond with extremely high sensitivity to linear acceleration, (2) responses tend to manifest simple trigonometric resolution of linear acceleration applied to the end-organ, and (3) the otolith units do not appear to have a single dynamic dependence upon acceleration. Author

N73-11069 Defence Research Board, Ottawa (Ontario).
MAN-MACHINE INTEGRATION: A LONG TERM LOOK
G. Melvill Jones *In its* DRB Aviation Med. Res. Unit Repts. Vol. 2: 1968-1971 Aug. 1972 p 191-228 refs Repr. from Aeronaut. J. (England), no. 72, 1968 p 831-846 (For availability see N73-11057 02-04)
(AMRU-R-68-3)

The prerequisites necessary for man to remain in control in man-machine integration are examined. These prerequisites include man's sensory input systems in the context of data acquisition from the machine and its environment and motor output in the context of neuromuscular control of the machine. The whole human organism as a component in the complete man-machine ensemble or control loop, as well as speculation on the impact of this entity, man-machine-hybrid, upon an evolving social structure are discussed. Author

N73-11070# Flying Personnel Research Committee, London (England).
A THEORETICAL MODEL OF THE UTRICULAR OTOLITH AND ITS RESPONSE TO ANGULAR MOTION WITH RESPECT TO AN ACCELERATION IN SHEAR
G. R. Barnes Apr. 1972 50 p refs
(FPRC-1315) Avail: NTIS HC $4.50

A theoretical model is developed for the utricular otolith and its associated neural connections to the oculomotor system, based upon established anatomical and electrophysiological features. The dynamic behavior of the model is analyzed, particularly in its response to angular motion with respect to an acceleration in shear. The predictions of the model with appropriate restraints are compared with data from experiments carried out in man. Author

N73-11071*# Translation Consultants, Ltd., Arlington, Va.
BEHAVIOR OF INTRAOCULAR PRESSURE, BLOOD PRESSURE AND BODY WEIGHT UNDER PEAK PHYSICAL EXERTION
R. Kern Washington NASA Nov. 1972 12 p refs Transl. into ENGLISH from Ophthalmologica (Basel), v. 147, 1964 p 82-92
(Contract NASw-2038)
(NASA-TT-F-14557) Avail: NTIS HC $3.00 CSCL 06P

Weight, blood pressure and intraocular pressure were measured in healthy young men prior to, and after a 50-km walk. Comparative tables show that on an average the weight and intraocular pressure decreases, while blood pressure increases. Author

N73-11072*# National Aeronautics and Space Administration, Washington, D.C.
MICROCOCCUS PIERANTONII. NEW SPECIES OF PHOTOGENIC BACTERIA OF THE LUMINOUS ORGAN OF RONDELETIA MINOR NAEF
Giuseppe Zirpolo Jun. 1972 20 p refs Transl. into ENGLISH from Boll. Soc. Nat. (Napoli), v. 32, 1919 p 75-87 Presented at the Soc. Nat. Session, 18 Aug. 1918
(NASA-TT-F-14439) Avail: NTIS HC $3.00 CSCL 06M

The photogenic bacteria (Micrococcus pierantonii) that constitute the luminous organ of Rondeletia minor NAEF are discussed. The isolated organ was pulped and inoculated in a broth of cuttlefish and agar. Within 24 hours luminous intense green colonies appeared. The effect of various broth cultures on the luminosity was studied. Summaries of the morphological cultural, and photogenic characteristics of the Micrococcus pierontonii are included. F.O.S.

N73-11073*# Baylor Univ., Houston, Tex. Dept. of Psychiatry.
EFFECTS OF STRESS UPON PSYCHOPHYSIOLOGICAL RESPONSES AND PERFORMANCE FOLLOWING SLEEP DEPRIVATION Final Report
Robert Roessler and Jerry W. Lester 20 Oct. 1972 36 p refs
(Contract NAS9-11753)
(NASA-CR-128620) Avail: NTIS HC $4.00 CSCL 06S

The usefulness of psychological and physiological variables in predicting performance under stress of 48 hours of sleep deprivation was investigated. Performance tests, with subjects of different ego strength personalities, in concept acquisition, reading comprehension, word association, word memory, and anagrams were conducted, and physiological measurements of (1) the phasic and tonic electrodermal, (2) galvanic skin response, (3) thermal skin resistance, (4) heart rate, (5) respiration, and (6) plethysmographic finger pulse volumn were recorded. It was found that the changes in the pattern of performance were the result of testing subjects at times when they would normally be sleeping, and that sleep deprivation longer than 48 hours must be maintained to produce changes in simple or well learned tasks. F.O.S.

N73-11074*# School of Aerospace Medicine, Brooks AFB, Tex.
BIOMEDICAL ACCEPTABILITY OF 45- TO 60-DAY SPACE FLIGHT Final Report, 1967 - 1969
John W. Ord and Stanley C. White Dec. 1971 29 p refs Sponsored by NASA
(AF Proj. 7755)
(NASA-CR-129131; AD-742974; SAM-Review-6-71; SAM-TR-71-35) Avail: NTIS HC $3.50 CSCL 06S

The principal known effects of the space flight environment upon the physiologic function of human subjects were reviewed as have the results and validity of biomedical ground-based simulation. Where known, the time courses of these physiologic changes were described. The ability to modify the deconditioning effects of space flight was discussed from the standpoints of improving the effectiveness of environmental control and life support systems and providing countermeasures (especially exercise) as a means of modifying the effects of weightlessness and a degree of physical inactivity. Biomedically, the current status of knowledge enables the prediction that 45 to 60 day manned space flights can be successfully accomplished. Author

N73-11075# Federal Aviation Administration, Washington, D.C. Office of Aviation Medicine.
G EFFECTS ON THE PILOT DURING AEROBATICS
Stanley R. Mohler Jul. 1972 20 p refs
(FAA-AM-72-28) Avail: NTIS HC $3.00

The increasing interest in the effects of acceleration forces on the human body as a result of improved aircraft performance and maneuverability is discussed. The following subjects pertaining to acceleration forces are presented: (1) the nature of aerobatic

g forces, (2) human physiology in relation to g forces, (3) human tolerances to various levels and times of exposure to g forces, and (4) methods by which tolerance to g forces can be increased. Author

N73-11076*# Techtran Corp., Glen Burnie, Md.
SIXTY AMBULATORY PATIENTS TREATED WITH SALVARSAN
E. Fruend Washington NASA Nov. 1972 12 p refs Transl. into ENGLISH from Muench. Med. Wochschr. (Munich), v. 6, 1911 p 302-305
(Contract NASw-2037)
(NASA-TT-F-14618) Avail: NTIS HC $3.00 CSCL 06E

Use of Salvarsan to treat sixty patients with various types of syphilis is described. Positive results as evidenced both by relief of symptoms (ulcers, etc.) and change of Wassermann test results from positive to negative are reported and compared with contemporary of other authors. Author

N73-11077*# Translation Consultants, Ltd., Arlington, Va.
WATER INTOXICATION AS A SIDE EFFECT OF CHLORPROPAMIDE THERAPY
E. Christensen and K. S. Rahbek Washington NASA Nov. 1972 9 p refs Transl. into ENGLISH from Ugeskrift. Laeger. (Copenhagen), v. 133, no. 41, Oct. 1971 p 2022-2025
(Contract NASw-2038)
(NASA-TT-F-14597) Avail: NTIS HC $3.00 CSCL 06E

A case of chronic overhydration with acute exacerbations is described in a patient suffering from psychogenic polydipsia treated with chlorpropamide. It is demonstrated that the cause of the condition in this patient was psychogenic intake of water in connection with inhibition of renal excretion of fluid caused by chlorpropamide. Attention is drawn to problems of fluid retention in chlorpropamide therapy in patients with diabetes mellitus and heart, liver or renal diseases. Author

N73-11078*# Translation Consultants, Ltd., Arlington, Va.
ADVANTAGES OFFERED BY THE USE OF FRUCTOSE AS MONOSACCHARIDE ADDED TO SALINE SOLUTIONS USED IN THE ORAL REHYDRATION OF INDIVIDUALS SUFFERING FROM GASTROENTERITIS
G. C. Biasini and A. Montaguti Washington NASA Nov. 1972 7 p refs Transl. into ENGLISH from Clin. Pediat. (Bologna), v. 49, 1967 p 624-628
(Contract NASw-2038)
(NASA-TT-F-14596) Avail: NTIS HC $3.00 CSCL 06E

Tests of monosaccharide absorption by administering saline solutions with fructose, and glucose, for the purpose of rehydration to two groups of children suffering with diarrhea showed that the saline solution with fructose has a better therapeutic effect. Author

N73-11079*# Techtran Corp., Glen Burnie, Md.
APPARENT PLASMA HYPEROSMOLALITY IN ALCOHOLIC INTOXICATION
M. Fontan, M. Caridroit, P. Parquet, and F. Cochez Washington NASA Nov. 1972 31 p refs Transl. into ENGLISH from Lille Med. (Lille), v. 12, no. 10, 1967 p 1320-1334
(Contract NASw-2037)
(NASA-TT-F-13910) Avail: NTIS HC $3.75 CSCL 06E

The term apparent osmolality refers to the measured value expressed in milliosmols/kg of water determined by means of osmometers-cryoscopes whose operating principle is based on the decrease in the freezing point as a function of the concentration of micro- or macro-molecular particles in the medium. The apparent osmolality of plasma increases parallel to the level of alcoholemia; it is not accompanied by a parallel decrease in the measured resistivity of the plasma. The hyperosmolality caused by the ethanol molecule does not correspond to a plasma hypertonia. Author

N73-11080# Office of Naval Research, London (England).
EUROPEAN SCIENTIFIC NOTES, VOLUME 26, NO. 6
Seymour L. Hess, ed. and Victoria S. Hewitson, ed. 30 Jun. 1972 35 p refs
(AD-746143; ONRL-26-6) Avail: NTIS CSCL 06/3

Contents: Aerospace research; Biological research; Origin of the solar system; Shipbuilding and ship research; Computer science; Potassium tantalum niobate; Diffraction gratings; Scientific devices exhibition; Cryogenics. GRA

N73-11081# California Univ., Los Angeles. Brain Research Inst.
EFFECTS OF HYDRAZINE ON ELECTROPHYSIOLOGY, BEHAVIOR AND RUNWAY PERFORMANCE IN THE CAT Final Technical Report
M. B. Sterman, M. D. Fairchild, and G. L. McRae May 1972 22 p refs
(Contract F33615-69-C-1441; AF Proj. 7163)
(AD-746014; AMRL-TR-71-82) Avail: NTIS CSCL 06/20

The effects of intraperitoneally administered hydrazine on electrophysiology, general behavior and integrated performance in cats was evaluated in a number of independent studies. Doses of 15 to 20 mg/kg hydrazine resulted in death 2 to 24 hours after administration, preceded by overt emesis, salivation, panting and hyperactivity. Doses of 5 to 10 mg/kg produced emesis, hyperactivity and loss of appetite resulting in extensive weight loss. Exposure to 2 to 4 mg/kg produced lethargy and mild weight loss only. In runway performance tests, 1.5 mg/kg produced no significant alterations on the day of administration, but completely disrupted performance within 48 hours. A dose of 0.75 mg/kg hydrazine had no effects on the day of administration, but disrupted or altered performance were observed following a dose of 0.375 mg/kg hydrazine. Very low dose exposure to hydrazine can significantly alter performance capability without producing overt behavioral or physiological symptoms.
Author (GRA)

N73-11082# California Univ., Los Angeles.
EFFECTS OF MONOMETHYLHYDRAZINE (MMH) ON EVOKED CEREBRAL NEUROELECTRIC RESPONSES Final Report
M. B. Sterman, M. D. Fairchild, T. Allison, W. R. Goff, and Kenneth C. Back Jun. 1972 15 p refs
(Contract F33615-69-C-1441; AF Proj. 7173)
(AD-746302; AMRL-TR-72-52) Avail: NTIS CSCL 06/20

Studies of the effects of monomethylhydrazine (MMH) on the cerebral neuroelectric evoked response in the unanesthetized cat revealed that convulsive doses of this compound consistently produced a large increase in the primary negative response of the somatic sensory cortex which progressively changed with time and approached peak levels starting approximately 1 hour before seizure onset. Delay of seizures with neuromuscular paralysis was observed also. The possible significance of this finding in relation to mechanism of action in the nervous system was explored. These results obtained with MMH are consistent with those previously reported for unsymmetrical dimethylhydrazine (UDMH). As herein reported, the evoked response changes are similar to results obtained with the convulsant agent Metrazol, suggesting that these response changes may be a useful index of impending seizure in a variety of toxic and clinical conditions. Author (GRA)

N73-11083# Miami Univ., Oxford, Ohio.
FACTORS AFFECTING THE DETECTION AND RECOGNITION OF COLORED TARGETS Final Technical Report, 1 Jul. 1970 - 15 May
Raymond M. White, Jr., Marvin J. Dainoff, and Richard E. Reynolds Wright-Patterson AFB, Ohio AMRL May 1972 228 p refs
(Contract F33615-70-C-1766; AF Proj. 7183)
(AD-746297; AMRL-TR-72-38) Avail: NTIS CSCL 06/16

The literature was reviewed in the areas of (a) effects of limited stimulus energy and background factors on the detection and recognition of colored signal lights and (b) determining factors affecting observer's performance in absolute identification of target colors. Five experiments were conducted to determine the effects of two classes of variables on an observer's ability to quickly and accurately identify the reflected color of a target background and reaction time. Author (GRA)

N73-11084# Radiation Research Associates, Inc., Fort Worth, Tex.
INITIAL RADIATION EXPOSURE FROM NUCLEAR WEAPONS Interim Report
Robert L. French and L. Glenn Mooney 15 Jul. 1972 89 p refs

(Contract DAHC20-72-C-0123)
(AD-745906; RRA-T7201) Avail: NTIS CSCL 06/18

Recent data and methods for predicting the initial radiation exposure at or near the ground surface resulting from the detonation of nuclear weapons were reviewed and evaluated. State-of-the-art methods were then selected or developed for neutron dose, secondary gamma-ray dose from neutron interactions in the air and ground, and fission-product gamma-ray dose occurring during the first minute following a detonation. The neutron and secondary gamma-ray method is based on discrete ordinates calculations of neutron transport in an air-over-ground geometry and first-last collision method for source height effects. The fission-product gamma-ray model is based on Monte Carlo air transport calculations. Author (GRA)

N73-11085# Army Medical Research and Nutrition Lab., Denver, Colo.

EFFECTS OF ALTITUDE ON THE CEBUS APELLA MONKEY

Larry J. Ackerman, Richard S. Demaree, Thomas J. Bucci, George A. Kennedy, Carl L. Alden, Tony S. Myers, and Ralph Lazzara Sep. 1971 51 p refs
(AD-745891; USAMRNL-328) Avail: NTIS CSCL 06/19

Previous studies have shown that abrupt translocation to high altitudes caused a cerebral edema in some humans. In this investigation Cebus apella monkeys were studied at sea level and 14,100 feet altitude to determine what extent cerebral spinal fluid dynamics, cerebral blood flow, and pathological changes of the brain and myocardium play in the pathogenesis of the symptoms of acute mountain sickness. Subhuman primates rapidly transported to 14,110 feet showed increased cerebral blood flow and increased cerebral spinal fluid pressure during the first five days of exposure to high altitude. Significant increases in the right ventricular/total heart weight ratios occurred after 5 days. After 3 months this ratio increased approximately 15% over sea level control values. This change was greater than that found in dogs but less than that in rats or rabbits after prolonged exposure. A mild perivascular cerebral edema occurred in some monkeys at 14,110 feet from 1 to 5 days. Monkey cardiac muscles showed edematous capillary endothelial cells after acute exposure to altitude, while prolonged exposure also caused swollen mitochondria and sarcoplasmic reticula with separation of myofibrils. Author (GRA)

N73-11086# Wrightsville Marine Bio-Medical Lab., Wilmington, N.C.

STUDIES CONCERNING THE HIGH PRESSURE HYPEREXCITABILITY IN THE SQUIRREL MONKEY Final Report, 1 Apr. - 31 Mar. 1972

Ralph W. Brauer 13 Jul. 1972 16 p refs
(Contract N00014-69-C-0341; NR Proj. 101-762)
(AD-745779) Avail: NTIS CSCL 06/19

Development of knowledge on the high pressure neurological syndrome (HPNS) in vertebrates is described on the basis of five years of investigative effort. Besides tracing the historical sequence of events, the report details experimentation aimed at providing a basis for predicting the onset of severe HPNS complications in man at various compression rates ranging from those in current use for cautious descent of subjects seeking to reach maximum depths to the very fast compression rates contemplated in relation with submarine escape techniques. A variety of other data concerning the HPNS are reviewed briefly from the points of view of their bearing upon design of prophylactic or therapeutic procedures, formulation of questions requiring additional clinical exploration, and elucidation of basic biophysical mechanisms. Attention is called to the fact that the underlying mechanisms seem to be common not only to all vertebrates tested, but to a rather similar sequence elicited by high pressures in many invertebrates. Problems of adaptation and of selection for individual variation are touched upon. Author (GRA)

N73-11087# Missouri Univ., Columbia. Space Sciences Research Center.

EFFECTS OF HYPEROXIA ON SULFHYDRYL CONCENTRATION OF ESCHERICHIA COLI

Jack L. Stees and Olen R. Brown Jul. 1972 26 p refs
(Contract N00014-67-A-0287-0002; NR Proj. 136-756)
(AD-746193; TR-4) Avail: NTIS CSCL 06/1

The concentration of reduced sulfhydryl (SH) in cell-free extracts of Escherichia coli grown with air as the gas phase was 26.8 plus or minus 1.2 nmoles SH/mg soluble protein. Exposure of bacteria to 1 ata of oxygen where growth continued but at a reduced rate, or to 6.2 ata of oxygen where growth was completely stopped, did not result in significant changes in intracellular SH concentration. Cell-free extracts exposed to 1.2 ata of oxygen resulted in SH oxidation at 0.5%/min, compared to 0.75%/min for reduced glutathione at 4.2 ata. Fractionation of cell-free extracts by ultrafiltration indicated that approximately 92% of the measurable SH-groups were protein-related. These data indicate that neither oxidation of intracellular SH, nor the relatively slow oxidation of surface SH-groups is a significant factor in the rapid growth inhibition of E. coli by hyperoxia. Bacterial reversal of possible intracellular SH oxidation during the interval between decompression and extraction was not excluded. Author (GRA)

N73-11088# SysteMed Corp., Dayton, Ohio.

CONTINUOUS ANIMAL EXPOSURE TO DICHLOROMETHANE Final Report

J. D. MacEwen, E. H. Vernot, and C. C. Haun May 1972 40 p refs
(Contract F33615-70-C-1046; AF Proj. 6302)
(AD-746295; W-71005; AMRL-TR-72-28) Avail: NTIS CSCL 06/20

Continuous exposures of dogs, monkeys, rats and mice to 5000 ppm and 1000 ppm of dichloromethane vapor (CH_2Cl_2) produced severe toxic effects on dogs, rats and mice. Dogs died after 3 weeks exposure to 1000 ppm and after 6 weeks exposure to 5000 ppm. Thirty percent of the mice also succumbed during four weeks exposure to 5000 ppm CH_2Cl_2. Although rats survived 14 weeks exposure to 5000 ppm, they experienced subnormal weight gains. Significant gross and histopathological hepatic lesions were noted in all 3 species at death or experimental termination in 14 weeks. In addition, rats showed abnormal kidney histopathology. Fat stains disclosed mild fatty increase in monkey livers after 14 weeks exposure to 1000 ppm CH_2Cl_2. Author (GRA)

N73-11089# Naval Submarine Medical Center, Groton, Conn. Research Lab.

PSYCHOLOGICAL EFFECTS OF PROLONGED EXPOSURE TO SONAR SIGNALS AT AN ELEVATED INTENSITY. 2: TWENTY-FOUR DAYS EXPOSURE TO SIGNALS AT 85 dB Interim Report

Benjamin B. Weybrew and Ernest M. Noddin 6 Dec. 1971 32 p refs
(AD-746103; NSMRL-691) Avail: NTIS CSCL 06/19

Ten carefully screened male subjects, 5 civilian men from the New London community and 5 Navy sonarmen were secluded in the Audiology spaces of the Submarine Medical Research Laboratory for a total of 30 days, 4 pre-experimental (no beep), 24 days: exposure to the 85 dB beep and 2 recovery days. Administered daily, the test battery consisted of a sequential reaction time test, a hand-eye coordination test, a measure of muscular tension and 4 measures of mood and affect. Although in 8 of the ten men some depressive trends occurred in the first 3 days of the exposure period, the performance data demonstrated no evidence of significance impairment. Similarly, while 3 men reported mild re-occurring headaches, and 5 indicated the beep may have affected their sleep as well as their performance on certain testing procedures, the overall adjustment of the 8 men did not appear to be impaired allowing 1/2 - 3 days for adaptation. Author (GRA)

N73-11090# Army Combat Developments Command Medical Service Agency, Fort Sam Houston, Tex.

FATIGUE IN SUSTAINED TACTICAL OPERATIONS Ph.D. Thesis

P. B. Petersen 29 Jun. 1972 171 p refs
(AD-746643) Avail: NTIS CSCL 06/16

Concepts for future U.S. tactical operations envision man's capabilities as encompassing rapid acclimation, fatigue reduction, changed wake-sleep cycles, and changes to the circadian cycle under sustained and continuous operational requirements. U.S. forces must be able to deal with an enemy who may have these capabilities. The study focuses on concepts for the reduction of fatigue in its various stages in sustained tactical operations, techniques of leadership, and on measures to prevent fatigue. Author (GRA)

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N73-11091*# Stanford Univ., Calif. Dept. of Electrical Engineering.
APPLICATION OF FREQUENCY DISCRIMINATION TECHNIQUE TO THE ANALYSIS OF ELECTROENCEPHALOGRAPHIC SIGNALS
D. C. Lai and R. L. Lux (Utah Univ.) Oct. 1972 7 p refs Repr. from Proc. of the 28th Ann. Natl. Electron. Conf., Oct. 1972
(Contracts NGR-46-001-038; NGR-05-020-575; Contract DAHC15-72-C-0232)
(NASA-CR-129173) Avail: NTIS HC $3.00 CSCL 06B

A frequency discrimination technique is realized by an inexpensive frequency discriminator for direct on-line measurement of the entrainment phenomenon in EEG as entrained by the frequency of a sensory stimulus. The use of this device for detecting the presence or absence of the stimulus effect and the measurement of the time delays in the entrainment is demonstrated. The EEG signal is first filtered by a narrow-band filter with center frequency about the alpha-rhythm of the individual. It is then reasonable to consider the alpha signal as narrow-band random process with the alpha frequency f sub alpha as the mean frequency of the spectral band. Author

N73-11092# Research Inst. of National Defence, Stockholm (Sweden).
CAN ATTENTION BE DIVERTED?
Rune Johonsson and Agneta Jonsson Sep. 1971 25 p refs In SWEDISH; ENGLISH summary
(FOA-2-C-2482-H5) Avail: NTIS HC $3.25

Tachymeter studies are reported to determine the contrast difference required for detecting a target against a background of spot noise and terrain picture, respectively. It is shown that it is possible to direct the attention of an observer successfully towards the desired target. A delaying factor can be demonstrated but many other factors appear to interfere with it. Author

N73-11093*# General Dynamics/Convair, San Diego, Calif.
STUDY OF PHYSIOLOGICAL AND BEHAVIORAL RESPONSE TO TRANSITIONS BETWEEN ROTATING AND NONROTATING ENVIRONMENTS
James F. Brady Washington NASA Nov. 1972 70 p refs (Contract NAS1-10775)
(NASA-CR-2130; GDCA-DBD72-001) Avail: NTIS HC $3.00 CSCL 06S

Future manned space missions may require transition between artificial gravity and weightlessness environments. The frequency and rate of such transition will influence the psychophysiological responses of man. Abrupt transfers are examined between such rotating and nonrotating environments to determine the physiological and behavioral responses of man. Five subjects were tested using rates of rotation up to 5 rpm. Author

N73-11094# Civil Aeromedical Inst., Oklahoma City, Okla.
A COMPARATIVE STUDY OF FEMALE AND MALE AIR TRAFFIC CONTROLLER TRAINEES
Bart B. Cobb, John J. Mathews, and Carolyn D. Lay May 1972 25 p refs
(FAA-AM-72-22) Avail: NTIS HC $3.25

This study compares age, education, pre-FAA experience, aptitudes, training-course performance measures, and post-Academy attrition rates of the 83 women who entered basic air traffic control (ATC) training at the FAA Academy during November 1968 through March 1970 with those of various samples of the 3,760 males who entered training during the same period. The study revealed no significant differences between the means of the female and male trainees with respect to age and educational level. The means of the training course grade averages of the two groups differed by only three-tenths of one point and there was no significant difference between the Academy attrition rate of 20.5 per cent for the females and 23.2 per cent for the 798 males. However, the groups differed markedly with respect to post-Academy attrition rates. It was determined that 33.3 per cent of the 66 females who completed Academy basic training were no longer in the air traffic management system as of April 1971 whereas only 19.1 per cent of the 613 males (within the sample of 798) who graduated from the Academy were subsequently attrited. Author

N73-11095*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif. Biotechnology and Power Dept.
TEST RESULTS OF SIX-MONTH TEST OF TWO WATER ELECTROLYSIS SYSTEMS
E. S. Mills and G. W. Wells Oct. 1972 559 p refs (Contract NAS9-12048)
(NASA-CR-128629; MDC-G3019; MSC-07382) Avail: NTIS HC $30.00 CSCL 06K

The two water electrolysis systems used in the NASA space station simulation 90-day manned test of a regenerative life support system were refurbished as required and subjected to 26-weeks of testing. The two electrolysis units are both promising systems for oxygen and hydrogen generation and both needed extensive long-term testing to evaluate the performance of the respective cell design and provide guidance for further development. Testing was conducted to evaluate performance in terms of current, pressure, variable oxygen demands, and orbital simulation. An automatic monitoring system was used to record, monitor and printout performance data at one minute, ten minute or one-hour intervals. Performance data is presented for each day of system operation for each module used during the day. Failures are analyzed, remedial action taken to eliminate problems is discussed and recommendations for redesign for future space applications are stated. Author

N73-11096# Civil Aeromedical Inst., Oklahoma City, Okla.
SELF-ESTIMATES OF DISTRACTIBILITY AS RELATED TO PERFORMANCE DECREMENT ON A TASK REQUIRING SUSTAINED ATTENTION
Richard I. Thackray, Karen N. Jones, and R. Mark Touchstone Jul. 1972 9 p refs
(FAA-AM-72-25) Avail: NTIS HC $3.00

Increasing automation of air traffic control tasks may have the undesirable side effect of increased monotony as a result of the anticipated reduction in task demands. In the present study, 50 subjects performed a monotonous, but perceptually demanding task, for approximately 30 minutes without rest. It was found that high-distractibility subjects (as determined from a questionnaire administered prior to the experiment) showed increasing lapses of attention during performance, while low-distractibility subjects failed to show any evidence of a decline in attention. Significant changes were obtained for respiration, respiration-period variability, heart-rate variability, and skin conductance during the task period, but the magnitude of these changes did not differ among the two distractibility groups. Author

N73-11097*# George Washington Univ., Washington, D.C.
ARTERIAL PULSE WAVE PRESSURE TRANSDUCER Patent Application
Chung Kim, Donald Gorelick, and Wayne Chen, inventors (to NASA) Filed 25 Sep. 1972 14 p
(NASA-Case-GSC-11531-1; US-Patent-Appl-SN-291845) Avail: NTIS HC $3.00 CSCL 06B

An arterial pulse wave pressure transducer is described. The transducer is comprised of a fluid-filled cavity having a flexible membrane over the cavity and adapted to be placed on the skin over an artery. An arterial pulse wave creates pressure pulses in the fluid which are transduced by a pressure-sensitive transistor disposed in direct contact with the fluid into an electric signal. The electrical signal is representative of the pulse waves and can be recorded so as to monitor changes in the elasticity of the arterial walls. NASA

N73-11098# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
AN UNSTABLE STEERING TASK WITH A SONIC BOOM DISTURBANCE

K. W. Lips Sep. 1972 53 p refs
(UTIAS-TN-179) Avail: NTIS HC $4.75

An initial study was made concerning the effect of sonic boom disturbances on an individual's compensatory tracking performance for an unstable system. The tracking task simulated automobile driving. It was found that most individuals were disturbed and recovered in varying degrees. These preliminary results, although somewhat qualitative, show that useful data can be obtained from this type of simulation. Author

N73-11099# Defence Research Information Centre, Orpington (England).
CALCULATION OF THE THERMAL RESISTANCE OF THE AIR LAYERS IN AIR-PERMEABLE CLOTHING
V. I. Yankelevich Jul. 1972 9 p refs Transl. into ENGLISH from Tekhnol. Tekst. Prom, (USSR), no. 2, 1971 p 111-115
(AD-746037; DRIC-Trans-2717; BR-30094) Avail: NTIS CSCL 06/17

The thermal resistance of the air layers in clothing which allows air to permeate through it was investigated. The method described for calculating the thermal resistance of air-permeable articles making allowance for the thermal resistance of the air layer yields results close to the experimental ones. This makes possible the reliable design of heat protective clothing for any given conditions of work or climate. GRA

N73-11100# School of Aerospace Medicine, Brooks AFB, Tex.
EVALUATION OF LASER EYE PROTECTORS COMMERCIALLY AVAILABLE Technical Report, Feb. 1969 - Jun. 1971
Donald R. Marston, Peter C. Landieri, and Patrick D. Walker Jul. 1972 38 p refs
(AF Proj. 7784)
(AD-746293; SAM-TR-72-8) Avail: NTIS CSCL 06/17

The transmission characteristics of commercially available laser eye protectors were measured with a Cary 14 spectrophotometer, to determine the conformance of each to the respective manufacturer's specifications. The luminous transmission of each eye protector was calculated relative to a 5750 K blackbody source of illumination (an approximation of the sea-level illumination of sunlight), and generally proved to be consistent with that advertised by the respective manufacturer. These measurements were also used to determine qualitatively the protection wavelength region for each device. Each of the eye protectors was exposed directly to high-intensity radiation from the lasers in order to measure the high optical density (OD) inherent in most of these devices and to confirm that the specified OD was always maintained. The following types of lasers were used for these tests--a normal pulse neodymium, a Q-switch ruby, a normal pulse ruby, and a continuous-wave helium-neon. Also outlined in this report are some guidelines for the design, selection, and use of eye protectors. Author (GRA)

N73-11101# California Univ., Irvine.
BIOCYBERNETICS: AN INTERACTIVE MAN-MACHINE INTERFACE Semiannual Technical Report, 1 Jan. - 30 Jun. 1972
R. F. Thompson and T. J. Teyler 20 Jul. 1972 18 p refs
(Contract DAHC15-72-C-0121; ARPA Order A1001)
(AD-746179) Avail: NTIS CSCL 05/9

The research project described deals with the capability of training a human subject to control and/or interact with complex electronic or mechanical systems. Basically the project involves the detection of bioelectrical phenomena that are analogs of ongoing cognitive processes and the utilization of these phenomena to control external events. The project also allows the system being controlled to communicate with the human operator in either a feedback or an interactive manner. In bypassing the subject's manual or verbal response apparatus an appreciable time saving is achieved. By eliminating the normal feedback/interactive modes of communication currently employed by machines (generally visual signals produced mechanically or electronically) a further potential time saving is realized. However, the major advantage of the proposal is the virtually automatic control of systems operation by the trained subject.
Author (GRA)

N73-11102# Beta Industries, Inc., Dayton, Ohio.
A STATISTICAL EVALUATION OF THE INJURY POTENTIAL OF A SQUARE WAVE ENERGY ABSORBER Final Report
Norman S. Phillips, Richard W. Carr, and William B. Walcott Fort Eustis, Va. Army Air Mobility Res. and Develop. Lab. Jun. 1972 57 p refs
(Contract DAAJ02-70-C-0055; DA Proj. 1F1-62203-A-529)
(AD-745919; BII-214-5; USAAMRDL-TR-72-9) Avail: NTIS CSCL 06/19

The report presents a quantitative measure of the effects of energy absorber stroke length upon cumulative probability of injury. The response of a seated subject to a vertical deceleration pulse representing a helicopter crash was calculated for a given seat and clothing weight. The seat-man system was analytically supported by a square wave energy absorber selected to generate no greater than 23 G for a 5th percentile man. The calculated response, DRI, provides a probability of spinal injury for the seated occupant. Since all parameters necessary for response computations had known statistical properties, it was possible to calculate the joint probability of injury for a particular deceleration pulse and subject weight. By calculating the statistical values for many deceleration and weight combinations, sufficient to represent the total population of both, a cumulative probability of injury was generated. Stroke length of the energy absorber required for each combination of deceleration and weight was calculated. By examining the effects of a limited stroke length, it was possible to generate a curve of stroke length available versus cumulative probability of injury. The curve indicates that for a realistic stroke length (12 inches), the cumulative probability of injury is 0.119. By doubling the stroke available or by halving it, the cumulative probability is decreased or increased by 7 percent. Comparisons with previously reported data indicate that the injury potential of the square wave is significantly higher than is theoretically achievable. Author (GRA)

N73-11103# Navy Clothing and Textile Research Unit, Natick, Mass.
EVALUATION OF HEAT LOSS FROM NAVY DIVERS' WET SUIT
Dale A. Reins and James C. Shampine Jul. 1972 24 p refs
(AD-747276; TR-102; Rept-4-70) Avail: NTIS CSCL 06/17

In a series of over 200 tests, subjects wore standard, 3/16 inch, closed-cell neoprene-foam, air-sea rescue suits in water of 55, 45, and 35 deg. F. The tests were designed to identify areas of the body where major heat losses occur. Other physiological parameters were monitored to assure the physical safety of test subjects while body temperature and metabolic rates were measured. Recommendations are made as to areas in which insulative values could be increased without hampering free movement of the wearer, and design modifications are suggested to limit free movement of water into and out of the suit. Author (GRA)

N73-11104# Rowland and Co., Haddonfield, N.J.
SUPPORT OF ADVANCED DEVELOPMENT OBJECTIVE 43-13, HUMAN FACTORS TECHNOLOGY Annual Report, 1 Dec. 1970 - 15 May 1972
Edward Marlowe, Carlos Escobar, and George E. Rowland 15 May 1972 142 p refs
(Contract N00014-70-C-0126; NR Proj. 154-319)
(AD-744984; R/C-72-3-108; AR-2) Avail: NTIS CSCL 05/9

The report describes the results and progress made in the continued development of a data management system to provide improved capabilities to handle the daily and historical performance data of Naval student pilots. The system will include data processing techniques for the extension of current student failure risk predictions of student training outcomes and, where feasible, the inclusion of data processing techniques that would aid in the achievement of individualized training goals. GRA

06 CHEMISTRY

Includes chemical analysis and identification (e.g. spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N73-11105 National Lending Library for Science and Technology, Boston Spa (England).
SOLUBILITY OF OXYGEN IN SODIUM AT 150 - 2 - 30 C
H. U. Borgstedt, H. Schneider, and G. Wittig 10 Jul. 1972 p Transl. into ENGLISH from Atominirtschaft (Duesseldorf), Mar. 1972 p 157-158
(NLL-Risley-TR-2424-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A distillation method was used to determine the saturation curve of sodium oxide in sodium within the temperature range 150 to 230 C using sodium samples with clearly difined oxygen content. Oxygen determination was carried out indirectly by determining sodium in the distillation residue through measurements and flame photometric methods. G.G.

N73-11106*# Rocketdyne, Canoga Park, Calif.
TETRAPERCHLORATE OF METHANE Final Report, 11 Mar. 1971 - 10 Mar. 1972
C. J. Schack 30 May 1972 25 p refs
(Contract NAS2-6399)
(NASA-CR-129168; R-8957) Avail: NTIS HC $3.25 CSCL 07D

The preparation of the tetraperchlorate of methane (TPM) was attempted. Displacement of halogen from carbon tetrahalides was accomplished with either CCl4 or CBr4 using the halogen perchlorates, ClOClO3, and BOClO3. Although the displacement process was successful, the generated carbon perchlorate intermediates were not isolated. Instead, these species decomposed to COCl2, CO2, and Cl2O7. The vigorous displacement reaction that often occurred required moderation. Fluorocarbon solvents and chlorine perchlorate were successfully tested for compatibility, permitting their use in these synthetic reactions. While the sought for moderating effect was obtained, the net result of the displacement of halogen from CX sub 4 substrates was the same as before. Thus only CO2, COCl2, and Cl2O7 were isolated. Author

N73-11107*# Brown and Root, Inc., Houston, Tex.
ANTI-FOG COMPOSITION Patent Application
Dorrie L. Carmin, Jr. and Harry D. Morrison, inventors (to NASA) Filed 8 Sep. 1971 17 p
(Contract NAS9-7572)
(NASA-Case-MSC-13530-2; US-Patent-Appl-SN-178771) Avail: NTIS HC $3.00 CSCL 07D

An anti-fog coating liquid is described that consists of detergent base, water, glyceryl ether, and oxygen-compatible oil. The composition is used sucessfully to prevent fogging of space suit visors under maximum metabolic loads for 5 hours and longer. NASA

N73-11108*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A NUMERICAL ANALYSIS OF THE TRANSIENT RESPONSE OF AN ABLATION SYSTEM INCLUDING EFFECTS OF THERMAL NONEQUILIBRIUM, MASS TRANSFER AND CHEMICAL KINETICS Ph.D Thesis - Virginia Polytechnic Inst. and State Univ.
Ronald Keith Clark May 1972 267 p refs
(NASA-TM-X-68853) Avail: NTIS HC $15.50 CSCL 07D

The differential equations governing the transient response of a one-dimensional ablative thermal protection system undergoing stagnation ablation are derived. These equations are for thermal nonequilibrium effects between the pyrolysis gases and the char layer and kinetically controlled chemical reactions and mass transfer between the pyrolysis gases and the char layer. The boundary conditions are written for the particular case of stagnation heating with surface removal by oxidation or sublimation and pyrolysis of the uncharred layer occurring in a plane. The governing equations and boundary conditions are solved numerically using the modified implicit method (Crank-Nicolson method). Numerical results are compared with exact solutions for a number of simplified cases. The comparison is favorable in each instance. Author

N73-11109# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
LIQUID VAPOR EQUILIBRIUM IN THE BINARY SYSTEMS OF He-4 AND He-3 WITH nD2 AND nH2
M. J. Hiza Jul. 1972 67 p refs Sponsored by AEC
(NBS-TN-621) Avail: SOD $0.65 as C13.46:621

Experimental data are reported for the equilibrium liquid and vapor phase compositions of the He-4-nD2 and He-3-nD2 systems from 20 to 30 K and the He-4-nH2 and He-3-nH2 systems from 20 to 28 K. The maximum experimental pressures were 20 and 16 atm for the He-4 and He-3 systems, respectively. In addition, vapor pressures were measured from 20 to 34 K for nD2 and from 20 to 30 K for nH2. Values of Henry's constants, enhancement factors, K-values, and heats of solution were derived from the experimental data for each system. The derived properties are compared with those derived from previous data for the He-4-nH2, He-4-pH2, and He-3-nH2 systems. Author

N73-11110# Bureau of Mines, Bartlesville, Okla. Energy Research Center.
OXYGENATES IN AUTOMOTIVE EXHAUST GAS: ESTIMATION OF LEVELS OF CARBONYLS AND NONCARBONYLS IN EXHAUST FROM GASOLINE FUELS
D. E. Seizinger and B. Dimitriades 1972 31 p refs
(BM-RI-7675) Avail: NTIS HC $3.75

The Bureau of Mines has developed analytical methods, primarily gas chromatographic, for measurement of exhaust oxygenates produced from selected simple fuels. The resulting data were used to estimate levels of carbonyls and noncarbonyl oxygenates in exhaust from gasoline fuels. Estimated noncarbonyl oxygenates in gasoline exhaust may comprise as much as 30 percent of total oxygenates which include unsaturated carbonyls and noncarbonyls believed to be significant potential pollutants. Author

N73-11111*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PROCEDURE FOR RAPID DETERMINATION OF NICKEL, COBALT, AND CHROMIUM IN AIRBORNE PARTICULATE SAMPLES
Warren F. Davis and Judson W. Graab Washington Nov. 1972 17 p refs
(NASA-TM-X-2672; E-7105) Avail: NTIS HC $3.00 CSCL 07D

A rapid, selective procedure for the determination of 1 to 20 micrograms of nickel, chromium, and cobalt in airborne particulates is described. The method utilizes the combined techniques of low temperature ashing and atomic absorption spectroscopy. The airborne particulates are collected on analytical filter paper. The filter papers are ashed, and the residues are dissolved in hydrochloric acid. Nickel, chromium, and cobalt are determined directly with good precision and accuracy by means of atomic absorption. The effects of flame type, burner height, slit width, and lamp current on the atomic absorption measurements are reported. Author

N73-11112*# Translation Consultants, Ltd., Arlington, Va.
STATISTICAL THEORIES OF SOLID SOLUTION HARDENING
R. Labusch Washington NASA Nov. 1972 22 p refs Transl. into ENGLISH from Acta Met. (London), v. 20, Jul. 1972 p 917-927
(Contract NASw-2038)
(NASA-TT-F-14711) Avail: NTIS HC $3.25 CSCL 07D

Theoretical approaches to the problem of solid solution hardening are critically analyzed, and some modifications and extensions to existing theories are suggested. The significant parameters of solid solution hardening are the concentration of solute atoms, the the range of interaction between solute atoms and dislocations, the strength of the interaction, and the line tension of the dislocation. Author

N73-11113*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
QUANTITATIVE SIMULTANEOUS MULTI-ELEMENT MICROPROBE ANALYSIS USING COMBINED WAVELENGTH AND ENERGY DISPERSIVE SYSTEMS
Louis S. Walter, Arthur S. Doan, Jr., Frank M. Wood, Jr., and Jospeh H. Bredekamp Nov. 1972 16 p refs Submitted for publication
(NASA-TM-X-66103; X-644-72-420) Avail: NTIS HC $3.00

CSCL 07D

A combined WDS-EDS system obviates the severe X-ray peak overlap problems encountered with Na, Mg, Al and Si common to pure EDS systems. By application of easily measured empirical correction factors for pulse pile-up and peak overlaps which are normally observed in the analysis of silicate minerals, the accuracy of analysis is comparable with that expected for WDS electron microprobe analyses. The continuum backgrounds are subtracted for the spectra by a spline fitting technique based on integrated intensities between the peaks. The preprocessed data are then reduced to chemical analyses by existing data reduction programs. Author

N73-11114# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

AN INTERFEROMETRIC DETERMINATION OF THE SPECIFIC REFRACTIVITIES OF THE NITROGEN AND OXYGEN ATOMS

Dale E. Wettlaufer Feb. 1972 49 p refs

(Grant AF-AFOSR-2274-72; AF Proj. 9783)

(AD-745132; UTIAS-TN-175; AFOSR-72-0411TR) Avail: NTIS CSCL 07/4

The specific refractivities (Gladstone-Dale constants) for nitrogen and oxygen atoms were determined experimentally using dual-frequency laser interferometry. The data were obtained in a hypersonic shock-tube facility using a Mach-Zehnder interferometer. GRA

N73-11115# Pittsburgh Univ., Pa. Space Research Coordination Center.

REACTION RATES OF URANIUM IONS AND ATOMS WITH O2 AND N2

R. Johnsen and Manfred A. Biondi May 1972 21 p refs

(Contract DA-31-124-ARO(D)-440)

(AD-746272; SRCC-171) Avail: NTIS CSCL 07/4

A drift mobility tube - mass spectrometer apparatus has been used to study the ion-molecule reaction, U(-) - O2 to UO(-) - O, from thermal (300 K) energy to about 10 eV ion mean energy. The corresponding reaction of U(-) - N2 is endothermic and not detected to occur up to about 10 eV ion energy. Chemi-ionization of uranium by the association reaction U - O2 to UO2(-) - e is detected. An estimate of the total reaction rate for U - O2, including the oxidation branch to produce UO - O, is given. Implications of these studies for ion cloud generation in the ionosphere are discussed. Author (GRA)

N73-11116# Princeton Univ., N.J. Dept. of Aerospace and Mechanical Sciences.

HIGH TEMPERATURE OXIDATION OF CARBON MONOXIDE AND METHANE IN A TURBULENT FLOW REACTOR Interim Report

Frederick L. Dryer Mar. 1972 317 p refs

(Grant AF-AFOSR-1649-69; AF Proj. 9711)

(AD-746284; AMS-T-1034; AFOSR-72-1109TR) Avail: NTIS CSCL 07/4

The high temperature oxidation reactions of carbon monoxide and methane in oxygen-rich atmospheres have been studied in a turbulent flow reactor. Spatial chemical sampling and gas chromatographic analysis techniques were developed for these studies, and the experimental methods are directly extendable to investigations of higher hydrocarbon oxidations. Overall expressions were developed for the carbon monoxide and methane disappearance rates and for the appearance rate of carbon dioxide in the methane-oxygen reaction. These and other data were used to deduce the relative importance of several elementary reactions in the oxidation mechanisms. It was concluded that other reactions in addition to hydroxyl attack on methane are important in governing the methane disappearance rate in oxygen-rich, high temperature systems. Author (GRA)

N73-11117# Tyco Labs., Inc., Waltham, Mass.

CATALYSIS OF HYDROCARBON OXIDATION WITH ADSORBED LAYERS Semiannual Report

S. B. Brummer, M. J. Turner, and S. D. Kirkland Jun. 1972 41 p refs

(Contract DAAK02-71-C-0117; DA Proj. 1T0-61102-A-34-A)

(AD-746258; C-108-3; SAR-3) Avail: NTIS CSCL 07/4

The oxidation of C3H8 at platinized Pt electrodes in H3PO4 containing Ni(2-), Na(-), or Zn(2-) was studied in half cells at 130C. In concentrated (=90%) H3PO4 there are long term performance decays for the oxidation of C3H8 which cannot be reversed by anodic or cathodic treatment of the electrode, but which can be reversed by cleaning the electrode in Na2CO3 solutions. Even with a clean electrode, the initial hydrocarbon oxidation rate is substantially lower in 95% acid than in 80% acid. In both 95% and 80% H3PO4, addition of Ni(2-) causes a maximum catalytic effect of about 100%. The magnitude of the catalytic effect is significantly affected by whether or not the previously mentioned Na2CO3 pretreatment is used. Na(-) or Zn(-2) had no apparent effect. GRA

N73-11118# Aerospace Corp., El Segundo, Calif. Lab. Operations.

MEASUREMENTS OF TEMPERATURES OF VIBRATIONALLY EXCITED N2 Technical Report, Feb. 1971 - Feb. 1972

Stephen J. Young and Kenneth P. Horn 14 Jun. 1972 49 p refs

(Contract F04701-71-C-0172)

(AD-746327; TR-0172(2793-01)-1; SAMSO-TR-72-172) Avail: NTIS CSCL 07/4

A comparison of the vibrational and rotational temperatures of microwave discharged N2 as measured by the CO tracer and the Penning ionization with He(2 triplet S) techniques has been performed in a flow tube apparatus. A vibrational temperature range of 1000 to 3000K was covered at a kinetic temperature of 350K. A detailed analysis of each technique is presented. The effect of pressure quenching of the N2(-)(1-) radiation occurring in the Penning ionization technique and the effect of vibrational temperature gradient across the flow tube in the CO tracer technique are discussed. The work represents the first experimental confirmation of this relationship. The agreement of rotational temperatures implied by the N2(-) and CO spectra indicates that the rotational distribution in BN2(-)(v) is not significantly distorted from the N2 equilibrium distribution by the heavy He(2 triplet S) impact. Author (GRA)

N73-11119# Aerospace Corp., El Segundo, Calif. Lab. Operations.

HF VIBRATIONAL RELAXATION MEASUREMENTS BY THE COMBINED SHOCK TUBE-LASER INDUCED FLUORESCENCE TECHNIQUE Final Report, Jun. - Dec. 1971

Jerry F. Bott 19 Jun. 1972 34 p refs

(Contract F04701-71-C-0172)

(AD-745953; TR-0172(2754)-2; SAMSO-TR-72-153) Avail: NTIS CSCL 07/4

Vibrational relaxation measurements in HF have been obtained at intermediate temperatures by combining the laser-induced fluorescence technique with shock compression heating in a shock tube. Usually, shock tube measurements of vibrational relation are limited to high temperatures, above about 1300 K in the case of HF. Laser-induced fluoresence measurements can be made in heated cells suitable for HF handling up to about 700 to 800 K. The combination of the two techniques offers several advantages including large range of temperatures, no wall reactions, and no leaky cells at high temperature. This method was used to obtain HF vibrational relaxation data at 460 to 1030 K. These data, together with shock tube data at high temperature (1350 to 3000 K), are compared with theoretical predictions. Author (GRA)

N73-11120# Naval Ordnance Lab., White Oak, Md.

ACOUSTICS MEASUREMENTS IN MOLTEN RUBIDIUM AT HIGH PRESSURES

Ira J. Rosenbaum 26 Apr. 1972 100 p refs

(AD-746838; NOLTR-72-107) Avail: NTIS CSCL 07/4

Velocity of sound in molten rubidium has been measured over the range 40-200 C and 0-20,000 PSI. The data was best fit by a polynomial which was linear in temperature and quadratic in pressure. Using an iterative technique, density, thermal expansion and isothermal compressibility were calculated over the range of the measurements. The change of internal energy, entropy and free energy with temperature and pressure were then calculated from the P-V-T data. The entropy of rubidium was used to estimate an effective hard sphere diameter and its variation with temperature and pressure for a model based on a perturbation expansion of the Helmholz free energy. Cohesive energies calculated to about one percent. Derivatives of the

free energy expansion were taken with respect to volume and sound velocities were calculated. Author (GRA)

N73-11121# Dow Chemical Co., Midland, Mich.
THERMALLY STABLE FLUOROPOLYMERS Final Report, 1 Feb. 1971 - 31 Jan. 1972
Harold E. Doorenbos and Hughie R. Frick Mar. 1972 39 p refs
(Contract N00019-71-C-0331)
(AD-747257) Avail: NTIS CSCL 07/3

The preparation of thermally and chemically stable fluoropolymers was investigated and this research is summarized. Three different fluoropolymeric systems were investigated in order to prepare elastomeric compositions. These were the poly (perfluorocyclobutanes), the poly(perfluorocyclobutyl perfluoroalkyl ethers), and the poly(perfluorocyclobutyl sulfides). Medium molecular weight polymers of the first system are friable solids. High molecular weight polymers of the second system vary from solids to liquids depending upon the ratio of cyclic/aliphatic perfluorinated groups present. Tractable polymers of the third type have not yet been attained. Because of the high reactivity of the sulfide group, uncontrolled crosslinking has occurred during polymer formation. Lower temperature reactions appear to be leading in the direction which may circumvent the crosslinking problem. Author (GRA)

N73-11122# Army Materials and Mechanics Research Center, Watertown, Mass.
HIGH TEMPERATURE MONOMERS: THE SEARCH FOR GRAPHITE PRECURSORS
Gail D. Mulligan and Steven Felman May 1972 20 p refs
(DA Proj. 1T0-62105-A-329)
(AD-746626; AMMRC-TR-72-13) Avail: NTIS CSCL 07/3

A series of disubstituted perylene compounds was studied in terms of their usefulness as monomers for high-temperature polymers and as possible binders for carbon fibers. A group of derivatives of 4,10-perylenedicarboxylic acid was synthesized and their solubilities and thermal behavior studied. In general, the monomers showed excellent thermal stability and in some cases good solubility in dimethylformamide. Methods of synthesis, characterization, and thermal behavior of the monomers are described. Author (GRA)

N73-11123# Yale Univ., New Haven, Conn.
NEGATIVE ION FORMATION AND ENERGY LOSSES IN MOLECULAR GASES Final Technical Report
George J. Schulz 15 Aug. 1972 32 p refs
(Contract N00014-67-A-0097-0008; ARPA Order 1479)
(AD-747304) Avail: NTIS CSCL 07/4

The report describes, in summary form, various cross section measurements for electron impact at low energies: Vibrational cross sections in N2, NO, CO2; dissociative attachment in the temperature range 300-1000 for O2 and CO2; the temperature dependence of three-body attachment in O2; the temperature dependence of total electron attachment near zero energy in SF6, CCl4, CFCl3, CH3I, CHCl3, CH2Br2, CF3Br, CH3Br.
Author (GRA)

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N73-11124 National Lending Library for Science and Technology, Boston Spa (England).
USE OF RELATIVE TRANSMISSION METHODS FOR TRANSMITTING SIGNALS (DIFFERENCE MODULATION)
N. T. Petrowitsch and A. A. Tschujko 27 Jul. 1972 13 p refs Transl. into ENGLISH from Nachrichtentechnik (East Berlin), v. 21, no. 8, Aug. 1971 p 278-281
(NLL-Trans-2835-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Difference methods are used to construct information transmission systems in channels with variable parameters; these systems approach the optimum and are easier to realize. Difference methods can also be used to transmit analog signals. The development of the general theory of difference methods, the establishment of these methods from the standpoint of the statistical decision theory, and the study and development of new variants provide new technical possibilities in the field of information transmission. Author

N73-11125 National Lending Library for Science and Technology, Boston Spa (England).
HUE DISTORTION EFFECT ON TELEVISION PICTURE QUALITY
J. Pazderak 27 Jul. 1972 18 p refs Transl. into ENGLISH from Rozhlasova Televisni Tech. (Prague), v. 15, no. 1, 1972 p 17-23
(NLL-Trans-2870-(9022.81))

Logistic functions of growth applied to dependence of television picture quality on the color tone change caused by phase shift of the color carrier are verified. Author

N73-11126 National Lending Library for Science and Technology, Boston Spa (England).
INTELSAT
Y. Fargette 27 Jul. 1972 8 p Transl. into ENGLISH from Rev. France. des Telecomun. (France), no. 2, Jan. 1972 p 53-56 (NLL-Trans-2860-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The development of telecommunications by satellite, and the operation of the Intelsat network for international communications are discussed. Topics discussed include: managerial section, space section, Comsat, and Intelsat new agreements, not yet signed by France. F.O.S.

N73-11127# Physics Lab. RVO-TNO, The Hague (Netherlands).
SEQUENTIAL DETECTION IN TWO STEPS
G. A. VanDerSpek Jun. 1972 26 p refs
(Ph-L-1972-20-ex-19; TDCK-60286) Avail: NTIS HC $3.50

Measurements were carried out to compare a sequential, two-pulse detection scheme with conventional single pulse detection. The measurements confirm the computed advantage of sequential detection. Author

N73-11128# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
SPEECH TRANSMISSION BY RADIO EQUIPMENT
H. J. M. Steeneken and T. Houtgast 1972 25 p refs In DUTCH; ENGLISH summary
(IZF-1972-14; TDCK-59867; A71/KL/023) Avail: NTIS HC $3.25

A survey is presented of disturbances determining the quality of speech transmission by a radio transmission link. The data given are adopted from publications and reports. These subjects are treated: (1) the measurement of the quality of a transmission link; (2) the influence of disturbances and signal processing on speech quality; (3) their relevance for the different parts of a radio communication link; and (4) a proposal for experiments on specific distortions. Author

N73-11129# Research Inst. of National Defence, Stockholm (Sweden).
SOME RESULTS IN CONNECTION WITH A SEARCH FOR MAXIMUM UNDERWATER LF/VLF COVERAGE
Rune Lindquist Apr. 1971 27 p refs Presented at AGARD, Electromagnetic-Wave Propagation Panel's Sci. Specialists Meeting on Electromagnetics of the Sea, Paris, 22-26 Jun. 1970
(FOA-3-C-3671-60) Avail: NTIS HC $3.50

A reasonable simple method of determining the underwater coverage from a radiostation in the LF/VLF range is considered. The sea water attenuation is computed from a map showing the distribution of salinity in the waters surrounding Sweden. The ground wave field strength as a function of frequency and distance has been computed by classical methods. Corrections have been added to take account of the influence of sky wave interference. The field strength required at sea level to permit reception at a certain depth has been determined by considering both thermal and atmospheric noise. Author

N73-11130# Research Inst. of National Defence, Stockholm (Sweden).
RADIATION DIAGRAM MEASUREMENTS ON ANTENNA FOR UHF COMMUNICATION TO FPL 35F
S. Dahlin Jun. 1971 53 p In SWEDISH; ENGLISH summary
(FOA-3-C-3678-61) Avail: NTIS HC $4.75

Radiation diagram measurements on a model surface to scale 1:10, with the antenna placed in the skin of an aircraft fuselage are examined. Measurements with external stores are given, as well as with two drop tanks and two Rb 27 missiles. Author

N73-11131# Research Inst. of National Defence, Stockholm (Sweden).
THE INFLUENCE OF THE LOWER IONOSPHERE ON WAVE PROPAGATION IN THE LF RANGE UP TO A DISTANCE OF 300 KM
L. Ladell Apr. 1971 47 p refs
(FOA-3-C-3673-60; Rept-18) Avail: NTIS HC $4.50

Calculations of the electric field strength of ionospheric waves are presented, assuming realistic ionospheric models. The earth magnetic field is neglected and the ionosphere is considered to be horizontally stratified. The calculations are made by a multislab approximation method, using a computer. It is determined that of the three different ionospheric profiles considered, only the night profile gives a seriously distrubing ionospheric wave.
Author

N73-11132# Research Inst. of National Defence, Stockholm (Sweden).
FREQUENCY CORRELATION IN TROPOSPHERIC PROPAGATION
Leif Jonasson May 1971 25 p refs In SWEDISH; ENGLISH summary
(FOA-3-A-3748-60(63)) Avail: NTIS HC $3.50

The theoretical correlation of signals with varying frequency spacing for propagation through the troposphere is considered. It seems that certain conclusions on the signal propagation paths can be drawn from the correlation characteristics. The report then deals with a series of experiments for determining the correlation characteristics. Based on the theoretical section, it is shown that the measured results indicate propagation along two propagation paths, and further that the propagation is not entirely turbulent. A practical consequence of this relationship is that in planning a propagation link one can take a significantly narrower spectrum than is assumed in international literature. Author

N73-11133# Research Inst. of National Defence, Stockholm (Sweden).
CRITERIA FOR EFFECTIVENESS OF COUNTER-MEASURES
S. A. Vakin and L. N. Sjustov Aug. 1971 91 p refs Transl. into SWEDISH from the book "Osnovy radioprotivodejstvija i radiotechniteskjoj razvedki" USSR In SWAHILI
(FOA-3-C-3644-66) Avail: NTIS HC $6.75

Information theory criteria for electronic jamming and countermeasures for air defense are presented. Guidance and tracking equipment are considered. Both active and passive jamming and chaff are discussed. Transl. by K.P.D.

N73-11134# Research Inst. of National Defence, Stockholm (Sweden).
TECHNICAL SIGNAL RECONNAISSANCE [TEKNISK SIGNALSPANING]
S. A. Vakin and L. N. Sjustov May 1971 110 p refs Transl. into SWEDISH from the book "Osnovy radioprotivodejstvija i radiotechniteskoj razvedki" USSR In SWAHILI; In SWEDISH
(FOA-3-C-3653-66) Avail: NTIS HC $7.50

The application of data handling theory to the solution of problems in signal reconnaissance is considered. A block diagram for a signal reconnaissance station is presented. Cartier frequency memory and methods of determining signal frequency are also discussed. Aspects of telemetry with regard to signal reconnaissance are considered. Transl. by K.P.D.

N73-11135# Technische Universitaet, Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
THE PRESSURE IMPULSE TECHNIQUE AND ITS IMPORTANCE TO SIGNAL PROCESSING EQUIPMENT Ph.D Thesis [DIE DRUCKIMPULSTECHNIK UND IHRE BEDEUTUNG FUER SIGNALVERARBEITENDE GERAETE]
Ulrich Schulte 22 Jun. 1971 107 p refs In GERMAN
Avail: NTIS HC $7.50

Basic principles of the hydraulic impulse technique and its application in information processing equipment are considered. Direct flow hydraulics employ one directional pipeline flow to activate equipment, whereas alternating fluid flow hydraulic elements are activated into either direction by a central impulse unit. Pulsating direct fluidic elements use superimposed alternating and direct hydraulic impulses. Logical connected hydraulic pressure impulses act as digital signals and provide energy for a computer in the form of a completely hydraulic signal flow.
Transl. by G.G.

N73-11136# Technische Universitaet, Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
A CONTRIBUTION TO THE SYSTEMS ENGINEERING OF SIGNAL PROCESSING EQUIPMENT Ph.D. Thesis [EIN BEITRAG ZUR KONSTRUKTIONSSYSTEMATIK SIGNALVERARBEITENDER GERAETE]
Klaus Schlottman 5 May 1971 137 p refs In GERMAN
Avail: NTIS HC $9.00

The various steps leading to functional concepts and construction of signal processing equipment are described in detail. Developed signal flow chains are characterized by their requirements, principles, and construction characteristics. A catalog of principles, according to technical signal laws, provides solutions for functional concepts and coordination with physical properties. Transl. by G.G.

N73-11137*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TELECOMMUNICATIONS SYSTEMS DESIGN TECHNIQUES HANDBOOK
R. E. Edelson, ed. 15 Jul. 1972 448 p refs
(Contract NAS7-100)
(NASA-CR-129108; JPL-TM-33-571) Copyright. Avail: NTIS HC $24.50 CSCL 17B

The Deep Space Network (DSN) increasingly supports deep space missions sponsored and managed by organizations without long experience in DSN design and operation. The document is intended as a textbook for those DSN users inexperienced in the design and specification of a DSN-compatible spacecraft telecommunications system. For experienced DSN users, the document provides a reference source of telecommunication information which summarizes knowledge previously available only in a multitude of sources. Extensive references are quoted for those who wish to explore specific areas more deeply. Author

N73-11138*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PERFORMANCE EVALUATION OF A CLASS OF SYSTEMATIC, RATE (M-1)/M, CONVOLUTIONAL CODES
Edward P. Greene Oct. 1972 34 p Submitted for publication
(NASA-TM-X-66085; X-522-72-403) Avail: NTIS HC $3.75 CSCL 09F

The implementation and performance evaluation are described for a class of rate (M-1)/M, systematic, convolutional codes being decoded with a simple majority logic decoder. The encoding logic appends one parity bit for each PCM telemetry word. It is shown that over the critical range of received PCM telemetry signal-to-noise ratios, this coding procedure produces a net coding gain of from 1.5 to 2.5 db relative to an equal power transmission of uncoded PCM telemetry. Being a low-redundancy systematic code, it is possible to process this data without convolutional decoding with a small rate loss penalty of about 0.5 db.
Author

N73-11139*# Alabama Univ., University. Dept. of Electrical Engineering.
PHASED ARRAY ANTENNA MATCHING: SIMULATION AND OPTIMIZATION OF A PLANAR PHASED ARRAY OF CIRCULAR WAVEGUIDE ELEMENTS Final Report
James E. Dudgeon Jan. 1972 80 p refs
(Contract NAS8-25894)
(NASA-CR-123820) Avail: NTIS HC $6.00 CSCL 09A

A computerized simulation of a planar phased array of circular waveguide elements is reported using mutual coupling and wide angle impedance matching in phased arrays. Special emphasis

is given to circular polarization. The aforementioned computer program has as variable inputs: frequency, polarization, grid geometry, element size, dielectric waveguide fill, dielectric plugs in the waveguide for impedance matching, and dielectric sheets covering the array surface for the purpose of wide angle impedance matching. Parameter combinations are found which produce reflection peaks interior to grating lobes, while dielectric cover sheets are successfully employed to extend the usable scan range of a phased array. The most exciting results came from the application of computer aided optimization techniques to the design of this type of array. Author

N73-11140*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MULTIPATH PROPAGATION STUDY FOR L-BAND, OVER-OCEAN, SATELLITE-AIRCRAFT COMMUNICATION LINK
Joseph H. Deal (Old Dominion Univ.) Aug. 1972 34 p refs
(NASA-TM-X-66094; X-752-72-335) Avail: NTIS HC #3.75 CSCL 17B

The results are presented of a study of multipath propagation between an aeronautical relay satellite in synchronous earth orbit and an aircraft flying over the ocean. An analytical model for the reflected power is developed and the results of a computer solution are compared with an approximate solution obtained through integration by the method of steepest descent. The computer solution is shown to differ considerably from the approximate solution. Both methods are compared with the limited experimental results available. Author

N73-11141*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SIMULATION RESULTS FOR THE VITERBI DECODING ALGORITHM
Bartus H. Batson, Robert W. Moorehead, and S. Zafar H. Taqvi (Lockheed Electron. Co., Inc.) Washington Nov. 1972 59 p refs
(NASA-TR-R-396; MSC-S-291) Avail: NTIS HC $3.00 CSCL 17B

Concepts involved in determining the performance of coded digital communications systems are introduced. The basic concepts of convolutional encoding and decoding are summarized, and hardware implementations of sequential and maximum likelihood decoders are described briefly. Results of parametric studies of the Viterbi decoding algorithm are summarized. Bit error probability is chosen as the measure of performance and is calculated, by using digital computer simulations, for various encoder and decoder parameters. Results are presented for code rates of one-half and one-third, for constraint lengths of 4 to 8, for both hard-decision and soft-decision bit detectors, and for several important systematic and nonsystematic codes. The effect of decoder block length on bit error rate also is considered, so that a more complete estimate of the relationship between performance and decoder complexity can be made. Author

N73-11142*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
PULSE CODE MODULATED SIGNAL SYNCHRONIZER Patent Application
Herbert S. Kobayashi, inventor (to NASA) Filed 8 Nov. 1972 28 p
(NASA-Case-MSC-12494-1; US-Patent-Appl-SN-304705) Avail: NTIS HC $3.50 CSCL 09E

A bit synchronizer for a split-phase PCM transmission has first and second loop systems which respectively receive incoming phase-coded PCM signals. In the first loop system the incoming bit signals are simultaneously supplied to two channels which alternately receive a generated, phase-coded bit signal representative of a binary digit, and the generated bit signal is multiplied with the incoming bit signals. The multiplied signals are respectively integrated and held. When the incoming signal is properly phase-locked with the generated bit signal each channel will produce an integrated value which increases (either positively or negatively) over the entire bit period of the generated bit signal. The channels are respectively sampled at the end of one bit period and at the beginning of the following bit period, and the sampled signals are supplied to a bit lock detector. Author

N73-11143# Elliott-Automation Space and Advanced Military Systems, Ltd., Camberley (England).
STUDY ON THE OPTIMUM DESIGN OF A FORMAT SYNCHRONISER Final Report
M. R. Kemp Jun. 1972 145 p
(Contract ESOC-381/71/AR)
(ESRO-CR(P)-127) Avail: NTIS HC $9.25

Results of a study on the optimum design of a format synchronizer for the ESRO control center system are detailed and the technical problems for the system are described. The original proposal is analyzed and problem areas identified. Each problem area is examined and a solution determined. The major system operations, i.e. control and assembly of the input data streams, data processing, decommutation, handling of time data, compilation of decommutated data into telemetry format, storage of set up data for time shared operation, and overall control system operation are discussed and allocated to different parts of the system. Data content and its flow through the system is discussed. A full description of the system operation under all likely conditions is given with flow charts. The likely cost of implementing the proposed system is indicated.
Author (ESRO)

N73-11144# Fernmeldetechnisches Zentralamt, Darmstadt (West Germany).
RADIATION DETECTION IN THE FAR INFRARED USING QUANTUM PHOTOCONDUCTORS [STRAHLUNGSNACHWEIS IM FERNEN INFAROT MIT QUANTEN-PHOTODETEKTOREN]
J. Vobian Mar. 1971 146 p refs In GERMAN
(FTZ-A-14-TBr-4) Avail: NTIS HC $9.50

The possibility of using quantum photodetectors for far infrared radiation detection, and possibly submillimeter wave reception, is investigated. The main problem is that for these wavelengths the detectors are limited to the internal photoeffect, due to low photon energy. The internal photoeffect can be used, as photoconductive, photovoltaic, and photoelectromagnetic effect. Photoconductive detectors are the most important for infrared reception. The photoconductive effect in impure semiconductors is especially suitable to submillimeter wave reception, at very low temperatures. The Rollin and Putley detectors are of special importance to submillimeter and millimeter wave reception. They have low time constants and high sensitivity. The detection mechanism differs from the photoeffect and is based on hot electron and cyclotron resonance effects. Author (ESRO)

N73-11145# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
TUBULAR ANTENNA IN A PLASMA: TRANSFORM TECHNIQUE
Michael A. V. Ward May 1972 68 p refs
(Contract N00014-67-A-0298-0005; Grant NSF GK-24105; NR Proj. 371-016)
(AD-746171; TR-632) Avail: NTIS CSCL 09/5

A Fourier transform method is developed to formulate the boundary value problem of a finite tubular antenna in free space and in a hot isotropic plasma. The Vlasov equation with collisions is used to describe the plasma. Author (GRA)

N73-11146# Connecticut Univ., Storrs.
STUDIES OF NAVY COMMUNICATIONS. 3: THE EFFECTS OF TIME/FREQUENCY DISTORTION ON THE PROSODIC FEATURES OF SPEECH Progress Report
Robert J. Duffy, Thomas G. Giolas, Harry S. Cooker, and Russell L. Sergeant (Naval Submarine Med. Res. Lab.) Groton, Conn. Naval Submarine Med. Res. Lab. 7 Sep. 1971 14 p refs
(Contract N00014-67-A-0197-0001)
(AD-746102; UCONN-IUVC/ONR-7) Avail: NTIS CSCL 17/2

In order to study the effects of time/frequency distortion on the prosodic features of speech, content-standard speech messages representing nine different emotions were subjected to reproduce ratios of 1.0, 1.8, 1.95, 2.05 and 2.15. These emotional speech stimuli were then presented to 50 Ss for identification of the intended emotion. The results demonstrated that identification scores were high for all emotions in the non-distortion condition and remained high for eight of the nine emotions under the most severe distortion condition. Compared to intelligibility scores which are more easily affected by

time/frequency distortion, the information carried by the prosodic features of speech was robust and resistant to distortion.
Author (GRA)

N73-11147# Computer Sciences Corp., Falls Church, Va.
SATELLITE COMMUNICATIONS REFERENCE DATA HANDBOOK
Jul. 1972 287 p
(Contract DCA100-72-C-0002)
(AD-746165) Avail: NTIS CSCL 17/2

The document provides a general survey of the background and present status of the satellite communications field in general and of Defense Satellite Communications System (DSCS) in particular. The main body of the report provides general and technical data on the major sub-systems of a satellite communications network. The orbital characteristics of the spacecraft and the performance characteristics of the satellite transponder are explained. The characteristics of earth terminal receivers and transmitters are also covered. An explanation of the basic principles of multiplex, modulation, coding, and multiple access techniques is provided and applied to satellite communications. The basic parameters and essential formulas for understanding the analysis and engineering of satellite links and systems follows. A series of appendices provides reference data directly relating to the DSCS. This includes descriptions of DSCS Phase I and II satellites, of various DSCS earth terminals (on hand and under development) and a description of the past, present and proposed phases of the DSCS. Also provided is data on future trends in the satellite communications field and numerous nomographs and tables that are helpful in analyzing satellite communications engineering problems. Author (GRA)

N73-11148# Ohio State Univ., Columbus. Electroscience Lab.
A RADAR TARGET DATA PROCESSING AND IDENTIFICATION SYSTEM
Kenneth J. Breeding Jun. 1972 85 p refs
(Grant AF AFOSR-1710-69; AF Proj. 9769)
(AD-746323; ESL-2768-8; AFOSR-72-1343TR) Avail: NTIS CSCL 17/9

A system is described which is capable of testing the identifiability of various targets based on their multifrequency radar returns. Three software packages designed to manipulate, analyze and identify multivariate data are described. In the first, called RADSYS, data may be input to the computer and manipulated in a number of ways such as interpolation, dimensionality reduction by data component selection, normalization by a multiplicative constant, etc. RADSYS also contains a recognition routine which uses a nearest neighbor rule for the identification of data sets. The second package, called DAD, is used to project the n dimensional data sets onto a two dimensional plane and display this data on a CRT. The final program, called MST, is used to compute the minimal spanning tree of arbitrary sets of data. Author (GRA)

N73-11149# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
THE TRACK ESTABLISHMENT PROCESS IN A MIXED FALSE-ALARM-RATE ENVIRONMENT
Robert D. Turner and Stanley Marder Jun. 1972 127 p refs
(Contract DAHC15-67-C-0011)
(AD-746513; P-728; IDA/HQ-72-13898) Avail: NTIS CSCL 17/9

The problem of extracting tracks of moving targets from sensor detections accompanied by a dense mixture of random false detections and recurrent false detections from stationary sources is examined. Algorithms for removal of fixed-target detections and for track establishment of moving targets are evaluated in terms of the tolerable false-alarm rate and minimum probability of detection for realizing a specified false-track-establishment rate and a specified probability of track establishment for moving targets, within a specified number of scans of the surveillance sensor. Some operational implications are briefly discussed in the form of a constrained resource allocation problem. Means for and benefits of multiple-sensor correlation are considered, and the problems introduced in attempting to provide surveillance of a mix of target types exhibiting significantly different kinematic characteristics are discussed. Author (GRA)

N73-11150# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DESIGN STUDY OF THE ADVANCED SIGNAL PROCESSOR
Peter E. Blankenship, Bernard Gold, Paul G. McHugh, and Clifford J. Weinstein 22 Apr. 1972 90 p refs
(Contract F19628-70-C-0230; ARPA Order 1559; AF Proj. 649L)
(AD-745950; TN-1972-17; ESD-TR-72-101) Avail: NTIS CSCL 09/2

A design study has been carried out for a general-purpose signal processing computer which incorporates arithmetic parallelism in a microprocessor structure. The study indicates that the processor (Advanced Signal Processor, ASP) would be faster, smaller, simpler, and less costly than its predecessor, the Fast Digital Processor (FDP). In addition, the ASP would have a more sophisticated in-out system than the FDP. These gains are achievable partially because of newly available fast hardware and partially due to the architecture of the ASP.
Author (GRA)

N73-11151# California Inst. of Tech., Pasadena. Antenna Lab.
ELECTROMAGNETIC WAVE PROPAGATION AND RADIATION IN A SUDDENLY CREATED PLASMA
Ching-Lin Jiang May 1972 83 p refs
(Grant AF AFOSR-1935-70; AF Proj. 9768)
(AD-746329; TR-63; AFOSR-72-1230TR) Avail: NTIS CSCL 20/14

Propagation and radiation of electromagnetic waves from oscillating sources in a suddenly created plasma are studied in the investigation. Field expressions are derived through the use of Laplace transformations. The spatial distribution of sources is taken to be arbitrary but confined. Two cases are considered in detail: (1) plane wave propagation in a source-free region, and (2) electric point dipole radiation. In the case of plane wave propagation, various aspects such as wave split, frequency shift, phase and group velocities, amplitude changes, power flows and energy relations are discussed. In the case of electric dipole radiation, the electromagnetic fields and instantaneous radiated power are calculated and expressed in terms of Lommel functions of two variables. Author (GRA)

N73-11152# Avco Corp., Cincinnati, Ohio. Electronics Div.
RADIO SET AN/PRC-70 ( ) Quarterly Report, 1 Jan. 1 Apr. 1972
C. A. Bucher May 1972 57 p
(Contract DAAB07-71-C-0319)
(AD-745918; Rept-80045-PRC-35/572; ECOM-0319-3; QR-3) Avail: NTIS CSCL 17/2

The third quarterly report covers the development work to date on the AN/PRC-70 HF/VHF Radio Set for manpack usage. The primary effort of this interval has been in the areas of breadboard work, module layout, and the continued evaluation of module and system technical approaches. Author (GRA)

N73-11153# Naval Research Lab., Washington, D.C.
COMPUTER PLOTS OF ATTENUATION IN STANDARD RECTANGULAR WAVEGUIDES Final Report
Lamont V. Blake Jun. 1972 43 p refs
(SF11141005)
(AD-746108; NRL-MR-2458) Avail: NTIS CSCL 09/1

A FORTRAN computer plotting program has been developed to plot the attenuation of air-filled rectangular waveguide for the TE(10) mode, in the frequency range from about cutoff to three times cutoff. Plots are presented for military standard waveguides in the range 300 MHz to 50 GHz. The basic equations on which the program is based and a listing of the program are given. Author (GRA)

N73-11154# Naval Submarine Medical Center, Groton, Conn.
DESIGN CONSIDERATIONS FOR A MICROPHONE-EQUIPPED MOUTHPIECE FOR NAVY DIVER COMMUNICATION Interim Report
Joseph S. Russotti and Russell L. Sergeant 14 Jan. 1972 10 p
(AD-746105; NSMRL-695) Avail: NTIS CSCL 17/2

The paper presents design considerations of a microphone-equipped breathing mouthpiece for enhanced underwater swimmer communications. Toward this objective, emphasis was placed upon providing increased freedom for articulatory movement as

well as a larger speaking cavity for less restriction to the speech flow while maintaining protection from the dangers of CO2 build-up in the breathing mixture. Author (GRA)

N73-11155# Connecticut Univ., Storrs. Dept. of Speech.
VARIABILITY AMONG TEN TALKERS OF WORD INTELLIGIBILITY IN NOISE Medical Research Progress Report
Barbara Kirk, Susan Marks, and Russell L. Sergeant 12 Jan. 1972 19 p refs
(Contract N00014-67-A-0197-0001)
(AD-746104; NSMRL-693; PR-5) Avail: NTIS CSCL 17/2

It may not be good practice to depend upon a single voice in assessing the performance of a communication system. Even when each of ten talkers with dialect-free speech, who spoke at a comfortable level, were equated for acoustic intensity, one talker yielded a performance of 75.5% words correct, another only 47.5%. It would be necessary to take the average intelligibility of any five of these talkers properly to assess a communication system. A great deal of research needs to be done in studying the acoustic and perceptual cues which render a particular voice highly intelligible in noise. GRA

N73-11156# Electrophysics Corp., Nutley, N.J.
INFRARED LASER/SONAR BEAM INTERACTION AT SEA AIR INTERFACE
L. M. Vallese May 1972 15 p refs Presented at the Natl. Infrared Inform. Symp. (IRIS) (20th), Gaithersburg, Md., 16 May 1972
(Contract N00014-71-C-0043)
(AD-746106) Avail: NTIS CSCL 17/2

A novel technique for direct communication between an aircraft and a submarine, based on the use of laser beams in air and sonar beams in the sea, interacting at the sea surface, is described. Initial laboratory feasibility studies are described. Author (GRA)

N73-11157# Mitre Corp., Bedford, Mass.
DETECTION PROBABILITIES OF LOG-NORMALLY DISTRIBUTED SIGNALS IN LOG-NORMALLY DISTRIBUTED NOISE
P. E. Gleason, J. D. R. Kramer, Jr., and R. M. ODonnell May 1972 64 p refs
(Contract F19628-71-C-0002; AF Proj. 4140)
(AD-745947; MTR-2215; ESD-TR-72-154) Avail: NTIS CSCL 17/9

The probability of detection as a function of signal-to-noise ratio, probability of false alarm, and signal-to-noise standard deviations has been calculated for log-normally distributed signals embedded in log-normally distributed noise. The probability of false alarm was varied from 0.01 to 10 to the -10th power, the standard deviation of the logarithm of the signal power from 9 to 3 dB, and the standard deviation of the logarithm of the noise power from 5 dB to 3 dB. Author (GRA)

N73-11158# Illinois Univ., Chicago. Dept. of Information Engineering.
HIGH-FREQUENCY SCATTERING METHODS
Piergiorgio L. E. Uslenghi Jul. 1972 93 p refs
(Grant AF-AFOSR-2263-72; AF Proj. 9749)
(AD-747044; AFOSR-72-1281TR) Avail: NTIS CSCL 20/14

A survey of the principal methods used to obtain the electromagnetic and acoustic scattered fields at high frequencies is presented. After a discussion of the Watson transformation, geometrical and physical optics are applied to a variety of scatterers with different shapes and made of different materials. Further refinements of these methods, such as the geometrical theory of diffraction and the theory of fringe waves, are described and compared with each other. A special section is devoted to the scattering by inhomogeneous madia. The accuracy of the methods is discussed, and comparisons are made with numerical and experimental data. Other results which are often useful in high-frequency scattering are given in the appendixes. Author (GRA)

N73-11159# Stanford Research Inst., Menlo Park, Calif.
FUNDAMENTAL NOTES ON INSTABILITY ANALYSIS Special Technical Report
Thomas N. C. Wang Jun. 1972 39 p refs
(Contract N00014-72-C-0402; ARPA Order 2141; SRI Proj. 1840)
(AD-746893) Avail: NTIS CSCL 20/14

In this special technical report the author presents fundamental studies on instability analysis. When an electromagnetic wave linearly interacts with an active medium or system, there can occur basically two types of instabilities. One of them, in which the wave grows indefinitely with time, is called absolute instability, and the other, in which the wave grows spatially as it travels, is called convective instability. By conformal mapping of the dispersion equation from omega onto the k plane or vice versa, the author has made a detailed analysis of these two types of instabilities. General procedures for analyzing instabilities are summarized. Effects of driving sources and the possible occurrence of branch cuts, in the k plane, of the dispersion equation are discussed. Author (GRA)

N73-11160# Texas Univ., Austin. Electronics Research Center.
AN OCTAVE BANDWITH CONSTANT BEAMWIDTH UNDERWATER RECEIVING ARRAY
Robert J. Holden and E. L. Hixson May 1972 64 p refs
(Contract F44620-71-C-0091; AF Proj. 4751)
(AD-746690; TM-34; AFOSR-72-1111TR) Avail: NTIS CSCL 17/1

A method for providing a constant beamwidth over an octave frequency bandwidth for an acoustical array is presented. This is accomplished by designing an array of the desired characteristics at lower band limit and a half scale model that will have the identical characteristics at twice that frequency. The outputs of these arrays are combined after filtering. The filter responses are derived by imposing the constant beamwidth constraints. Such an array was implemented to cover the octave 10 to 20 KHz. Two 5-element broadside arrays were combined but because of redundancy only 7 elements were required. Because of poor element frequency response and nonuniformity, the on-axis frequency response was not flat over the octave. However, the measured beamwidth was 20 plus or minus 1 degrees for a design value of 20.8 degrees. Author (GRA)

N73-11161# General Motors Corp., Santa Barbara, Calif. Delco Electronics Div.
A PRELIMINARY INVESTIGATION OF THE FEASIBILITY OF ICE MOUNTED GEOPHONE SONAR ARRAYS
Beaumont Buck and Bruce K. Murdock Apr. 1972 31 p refs
(Contract N00014-71-C-0152)
(AD-747327; TR-72-07) Avail: NTIS CSCL 17/1

The feasibility of replacing hydrophone arrays in water by geophone arrays in ice for use in passive sonar systems is investigated. Past work in deepwater, Spring conditions in the Arctic indicated that horizontal geophones implanted in pack ice have better signal-to-noise ratios than hydrophones in water below the ice, for frequencies below about 30Hz. This study took into consideration the problem of possible multipath propagation in the ice and the propagation velocity across an ice-implanted geophone array. Experiments were performed in the marginal zone of the Chukchi Sea. This area offered an expedient for early testing of geophone arrays by taking advantage of the Marginal Ice Zone - Pacific, 1971 Project. Author (GRA)

N73-11162# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ON THE REDUCTION OF RAINFALL OUTAGES BY SPACE DIVERSITY FOR MILLIMETER-WAVE EARTH-SATELLITE COMMUNICATIONS SYSTEMS, JULY 1971 - JANUARY 1972
Earl E. Reber and D. Vaughn McDonald 15 Apr. 1972 34 p refs
(Contract F04701-71-C-0172)
(AD-747022; TR-0172(2230-20)-9; SAMSO-TR-72-152) Avail: NTIS CSCL 17/2

Space diversity, i.e., judicious placement of several ground terminals within a predetermined area, is examined as a means of avoiding rainfall-induced blackouts of millimeter-wave earth-satellite communications systems. The concept of space diversity implemented by a primary station and four secondary stations within an 80-km radius is examined on the basis of hourly rainfall data for the 10-yr period from 1 January 1961

to 31 December 1970. The hours of selected categories of rainfall occurring simultaneously at each station are determined for three climatologically different regions of the United States. The hours of simultaneous rainfall occurring at the three widely separated primary stations are also determined. Results show that a spacediversity system with five stations in an 80-km radius will have at least one station free of rainfall at rates of 5 mm/hr 99.99% of the time. Author (GRA)

N73-11163# White Sands Missile Range, N.Mex.
TRANSFORMATIONS FOR RANGE INSTRUMENT COORDINATES AND THEIR TRACKING SPACE SINGULARITY REGIONS
James S. Pappas and Glenn A. Bookhout Jun. 1972 28 p
(AD-746637; WSMR-TR-35) Avail: NTIS CSCL 17/9

The non-linear transformations relating rectangular coordinates to range instrumentation coordinates for conventional radar, phased array radar, AME (Angle Measuring Equipment) etc., are considered. The transformations are linearly related through Jacobian matrices at the derivative (rate) and first differential or discrete difference (residuals or linearizing about a nominal) level. State variables near the singularity regions of these matrices can cause numerical computer problems for the unwary analyst. Author (GRA)

N73-11164# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
AN EXPERIMENTAL STUDY OF THE INTERACTION OF MODERATE POWER MICROWAVES WITH ELECTRON DENSITY GRADIENTS
Daniel J. Jacavanco 16 May 1972 58 p refs
(AF Proj. 4642)
(AD-746677; AFCRL-72-0306; AFCRL-PSRP-492) Avail: NTIS CSCL 20/14

The paper presents the results of an experiment which examines the interaction of a moderate power microwave signal with an inhomogeneous electron density gradient. The result of this interaction is a self-shielding plasma, generated by the absorption of 10 GHz microwaves, which propagates toward the energy source at a velocity which is a function of pressure, type of gas and incident heating field intensity. These results are essentially in agreement with the shock tube work of Bethke (1969) but are extended to show new and interesting effects of applying a transverse dc magnetic field to the test section. Magnetic field results suggest that heating of the electron gas occurs at the hybrid resonance frequency at magnetic fields below cyclotron, and propagation of the extraordinary mode is inhibited at low magnetic fields. Author (GRA)

N73-11165# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
THEORY OF PROPAGATION OF ELECTROMAGNETIC WAVES IN SPACE-TIME VARYING MEDIA
Ronald L. Fante 24 Apr. 1972 37 p refs
(AF Proj. 5635)
(AD-746676; AFCRL-FSRP-489; AFCRL-72-0264) Avail: NTIS CSCL 20/14

Using WKB (Wentzel-Kramers-Brillouin) methods the author has considered the propagation of electromagnetic waves in isotropic lossless media which vary slowly with both position and time. It is found that in such media the meaning of various quantities, such as the group velocity, must be reinterpreted. The theory is applied to study propagation in space-time varying dielectrics and plasmas. Author (GRA)

N73-11596* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CURRENT METHODS OF RADIO OCCULTATION DATA INVERSION
Arvydas J. Kliore *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 16 p (For availability see N73-11585 02-19)
(Contract NAS7-100)
CSCL 20N

N73-11600* Raytheon Co., Sudbury, Mass.
ERROR ANALYSIS OF BENT RAY RADIO OCCULTATION MEASURMENTS
R. L. SaintGermain *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 5 p (For availability see N73-11585 02-19)
CSCL 20N

N73-11615* Bojarski (Norbert N.) Moorestown, N.J.
ELECTROMAGNETIC INVERSE SCATTERING
Norbert N. Bojarski *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 14 p (For availability see N73-11585 02-19)
(Contracts AF 30(602)-3961; F30602-68-C-0260)
CSCL 20N

N73-11616* Purdue Univ., Lafayette, Ind.
SOME SPECIAL CASES OF THE ELECTROMAGNETIC INVERSE PROBLEM
V. H. Weston *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p refs (For availability see N73-11585 02-19)
CSCL 20N

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics.

N73-11166 National Lending Library for Science and Technology, Boston Spa (England).
ANALOGUE REDUNDANT CONTROLS WITH REDUNDYN COMPONENTS
Hermann Waldmann and Manfred Weibelzahl 27 Jul. 1972 7 p refs Transl. into ENGLISH from Siemens-Z. (Erlangen), v. 45, no. 10, 1971 p 747-749
(NLL-WH-334-(9091.9f)) Avail: Natl. Lending Library, Boston Spa, Engl: 1 NLL photocopy coupon

A three channel analog system for control and measurement processing is described that fulfills the highest demands with regard to operational reliability. A suddenly occuring fault in a nuclear plant is recognized, a warning is given and made non-effective by shutdown of the affected channel. The selector circuits installed for this operation are tested during operation. Author

N73-11167*# Michigan Univ., Ann Arbor. Willow Run Labs.
[ERTS COMPUTER COMPATIBLE TAPE DATA PROCESSING AND ANALYSIS] Bimonthly Progress Report, 1 Jul. - 31 Aug. 1972
Fabian C. Polcyn, Fred J. Thomson, L. J. Porcello, I. J. Sattinger, W. A. Malila, C. T. Wezernak, and Robert Horvath, Principal Investigators 31 Aug. 1972 12 p
(Contract NAS5-21783)
(E72-10201; NASA-CR-129067; Rept-11229-3-L; BMPR-1) Avail: NTIS HC $3.00 CSCL 09B

There are no author-identified significant results in this report.

N73-11168# Physics Lab. RVO-TNO, The Hague (Netherlands).
A PRINTOUT CONVERTER PRICO-03. PART 2: PRINTED CIRCUITS AND PLUG REGISTERS [EEN PRINT-OUT CONVERTER PRICO-03. DEEL 2: PRINTED CIRCUITS EN PLUGLIJSTEN]
A. Bruin Jan. 1972 81 p In DUTCH
(PHL-1972-4; TDCK-59730) Avail: NTIS HC $6.25

Data, circuit diagrams, and assembly instructions for printed circuits and plug registers of the printout converter are presented. Transl. by G.G.

N73-11169# Commission of the European Communities, Brussels (Belgium).
INTERACTIVE GRAPHIC VERSION OF S/360 CONTINUOUS SYSTEM MODELING PROGRAM USER'S AND SYSTEM MANUAL
A. Endrizzi 1972 21 p refs
(EUR-4836e) Avail: NTIS HC $3.25

A program for the simulation of continuous systems was developed. It provides an application-oriented input language that accepts problems expressed in the form of a system of ordinary

differential, algebraic and logical equations. Data input and output are facilitated by means of application-oriented control statements. This interactive-graphic version provides a flexible man-machine interface. The user communicates with his problem by means of an IBM 2250 display unit. The program gives the user the possibility of introducing and/or modifying the equations describing the model from the keyboard. It displays the diagnostics produced during the program translation and FORTRAN G compilation phases, and the user may change his input statements accordingly. While the system is integrating the equations, some variables, selected by the operator, are scaled and plotted on the screen. At any instant, the operator may stop the integration processes and, by light pen detection on a menu, select among following operations: select variables for x-y plotting, change scaling factors, display list of results, change the values of parameters, stop the run or resume integration at the point it was interrupted. Author

N73-11170# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
A COMPARISON OF DIFFERENT FIGURE TYPES TO BE USED IN A 5 x 7 MATRIX
H. J. Leebeek and A. T. V. D. Hazel-Bomas 1972 19 p In DUTCH; ENGLISH summary
(IZF-1972-11; TDCK-59825) Avail: NTIS HC $3.00

Figure series to be used in digital information presentation were compared with each other. The investigation was done by the aid of the tachistoscopic presentation. The seven-segment presentation appeared to give more confusion than the other types used in the test procedure. A series giving the best results is recommended. Author

N73-11171# Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany). Sektor Elektronik.
INVESTIGATIONS AND ELECTRONIC IMPLEMENTATION OF AUTONOMOUS INFORMATION TRANSFER BETWEEN PROCESS INSTRUMENTATION AND ON LINE COMPUTER
H. Pangritz Jun. 1972 133 p refs In GERMAN; ENGLISH summary
(HMI-B123; B-NDV-13) Avail: NTIS HC $8.75

A proposal is made for the organization of autonomous data transfers between process instrumentation and on line computer. In order to implement this proposal it is discussed, whether a minicomputer is suitable for controlling the data transfers between process instrumentation and main computer, and which features of such a control computer are required for handling a fairly large data rate. A hardware controller designed for this application is described, the major design criteria being high flexibility in hardware extensions, control performance and computer independence. This controller allows a data rate of 30.000 word/sec with 24 bit per word when using an appropriate on line computer. Author

N73-11172# Aeronautical Research Labs., Melbourne (Australia).
AN EIGHT-CHANNEL DIFFERENTIAL ANALOGUE MULTIPLEXER FOR AIRBORNE USE
M. D. Card Feb. 1972 24 p refs
(ARL/F-Note-49) Avail: NTIS HC $3.25

An eight channel, differential input, analog multiplexer has been developed for airborne applications. The multiplexer may be used for fast rate sampling, where reconstruction of low frequency data in continuous manner is performaed, and also for block sampling, where the data are sampled for time intervals long compared with the lowest frequency of interest. Author

N73-11173# Research Inst. of National Defence, Stockholm (Sweden).
DESCRIPTION OF A SUB-ROUTINE PACKAGE FOR SOLVING PROBLEMS MECHANICALLY BY THE POLICY ITERATION METHOD FOLLOWING HOWARD, WITH EXAMPLES AND APPLICATIONS [IN SWEDISH; ENGLISH SUMMARY]
A. Frausen Feb. 1971 51 p
(FOA-P-C-8287-X9) Avail: NTIS HC $4.75

The policy iteration method has been programmed for IBM/360 model 75 and is available in the form of a subroutine package. A brief description of the method and examples of the field of application with information about necessary restrictions are reported. The subroutine package is described with the potential user in view, and has precise instructions for carrying out subsequent runs. The administration routine which forms an integral part is worked through with respect to modifications that have to be made. The program lists in FORTRAN 4 are appended along with a worked example. Author

N73-11174# Research Inst. of National Defence, Stockholm (Sweden).
INTERNAL STRUCTURE OF THE SQAP NATURAL LANGUAGE PARSER
Jacob Palme Apr. 1971 84 p refs
(FOA-P-C-8286-11(64)) Avail: NTIS HC $6.25

The SQAP parser is the first part of a program to translate facts and questions from a semi-natural input language to the internal structure of the data base in a question-answering system. The parser produces a parsing tree for the transformational part of the program. Author

N73-11175# Research Inst. of National Defence, Stockholm (Sweden).
DEVELOPMENT TRENDS IN SMALL REAL TIME COMPUTER SYSTEMS
Lars-Ake Larsson Sep. 1971 16 p refs In SWEDISH; ENGLISH summary
(FOA-2-C-2484-E5) Avail: NTIS HC $3.00

Small, relatively cheap computers are being used increasingly for real time oriented information systems. Reliability of the system against mechanical faults is an important problem. The problems concerning contacts between programs and re-programming in a system with a number of interconnected computers is at present very great. There is a lack of qualified system engineers and programmers which emphasizes the need of standardization of required knowledge for programming the computer system. New program languages of high level type are being developed for real time applications. Author

N73-11176# Research Inst. of National Defence, Stockholm (Sweden).
PROCESS COMPUTER PROJECTS: PROJECT TECHNOLOGY AND PROJECT WORK
Lars-Ake Larsson Sep. 1971 24 p refs In SWEDISH; ENGLISH summary
(FOA-2-C-2485-E5) Avail: NTIS HC $3.25

Relatively cheap small computer systems are being used in greater numbers for automation in industry. The choice of the degree of automation and the consequent size of computer system, is determined partly by how much profit can be obtained by different alternative investments and partly by the costs of equivalents. There are two degrees of automation; dedicated computer control and process computer control. For process identification and model construction a medium sized computer system can be used (lab-computer system). Author

N73-11177# Joint Publications Research Service, Arlington, Va.
SPECIAL CONSIDERATIONS IN THE USE OF GEOMETRIC CODING IN TRANSFORMER STORAGE DEVICES
V. B. Smolov and Yu. D. Chekmarev 13 Oct. 1972 7 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (Leningrad), no. 7, 1972 p 73-77
(JPRS-57251) Avail: NTIS HC $7.00

Conditions and methods for employing the advantages of the number block structure are considered. The information capacity of a geometric code number line is defined. An evaluation of expenditures on the number of cores used and the number of connecting elements is made. Author

N73-11178# RAND Corp., Santa Monica, Calif.
PRIVACY AND SECURITY IN DATABANK SYSTEMS: MEASURES OF EFFECTIVENESS, COSTS, AND PROTECTOR-INTRUDER INTERACTIONS
Rein Turn and Norman Z. Shapiro Jul. 1972 37 p refs Proposed for presentation at the 1972 AFIPS Fall Joint Computer Conf., Anaheim, Calif., 5-7 Dec. 1972
(Grant NSF GI-29943)
(P-4871) Avail: NTIS HC $4.00

A structural model of databank systems is formulated, the

roles of its elements in providing, or threatening, of data privacy and security are discussed, and a suitable classification system is established. Withing this framework, a model of the economic interactions of the databank protector and potential intruders is developed. The variables of this model are the value of information to the subjects, protector and intruders; expenditures by the protector and the intruder; and effectiveness of data security as well as intrusion techniques. Various relevant characteristics of these variables and their relationships are discussed. Author

N73-11179# Naval Postgraduate School, Monterey, Calif.
A SURVEY AND ANALYSIS OF HIGH DENSITY MASS STORAGE DEVICES AND SYSTEMS
Norman F. Schneidewind, Gordon H. Syms, Thomas L. Grainger, and Robert J. Carden Jul. 1972 47 p refs
(AD-747134; NPS-55SS72071A) Avail: NTIS CSCL 09/2

A survey and analysis has been made of high density mass storage systems for the Navy Fleet Material Support Office. The purpose of the project was to survey mass storage devices and systems and to select several devices for detailed analysis. Representative devices were analyzed in order to determine their suitability for various file management functions.

Author (GRA)

N73-11180# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
AN APPLICATION OF QUASILINEARIZATION TO DIFFERENTIAL APPROXIMATION: ANALYTIC FUNCTION GENERATION
Art Lew Aug. 1972 9 p refs
(Contract AT(40-3)-113; Grant NSF GP-29049; Proj. 19)
(USC-113P19-27; TR-72-45) Avail: NTIS HC $3.00

An approach to computer generation of differentiable functions is considered, applicable to those functions definable by variable coefficient, linear or nonlinear differential equations. The approach taken is a generalization of least squares polynomial approximation. Approximation is by the solution to a constant coefficient, linear ordinary differential equation. It is shown that there exists a sequence of such differential equations, of increasing order, whose solutions converge uniformly to any differentiable function. Numerical results obtained on a digital computer were obtained for various functions. The method is practical, especially in the case in applications of analog computers and continuous simulation languages calling for analytic function generation.

Author

N73-11181# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
APPROXIMATION IN DISCRETE DYNAMIC PROGRAMMING
A. Lew Aug. 1972 10 p refs
(Contract AT(40-3)-113; Grant NSF GP-29049; Proj. 19)
(USC-113P19-26; TR-72-44) Avail: NTIS HC $3.00

The use of approximation techniques whenever exact solutions of discrete dynamic programming problems cannot be feasibly obtained is discussed. Author

N73-11182# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
IMAGE RESTORATION, MODELLING, AND REDUCTION OF DIMENSIONALITY
Edward Angel and Anil K. Jain Sep. 1972 30 p refs
(Contracts AT(40-3)-113; F08606-72-C-0008; Grants GM-16197-05; NSF GP-29049; Proj. 19)
(USC-113P19-31; TR-72-50) Avail: NTIS HC $3.50

A two-dimensional, second order Markov process representation is considered which can be used for fast recursive restoration of images with small storage requirements on a digital computer. Advantages of this method over existing techniques are illustrated. Author

N73-11183*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DESIGN OF A HIGH-SPEED REAL-TIME SYMBIONT
Eugene I. Grunby May 1972 19 p
(NASA-TM-X-66090; X-565-72-134) Avail: NTIS CSCL 09B

The problems involved, approach taken, and solution arrived at are described in a software study to design a high speed, real time symbiont for analog telemetry processing. The symbiont design is based on the need for transferring data from one I/O device to another without significant use of core space or central processor time. The queues, programmed wait states, and teletype commands incorporated in the symbiont design are discussed.

D.L.G.

N73-11184*# Computer Sciences Corp., Huntsville, Ala. Field Service Div.
OPTIMUM SPACEBORNE COMPUTER SYSTEM DESIGN BY SIMULATION
T. Williams, J. E. Weatherbee, and D. S. Taylor 1 Sep. 1972 38 p refs
(Contract NAS8-21805)
(NASA-CR-128997) Avail: NTIS HC $4.00 CSCL 09B

A deterministic digital simulation model is described which models the Automatically Reconfigurable Modular Multiprocessor System (ARMMS), a candidate computer system for future manned and unmanned space missions. Use of the model as a tool in configuring a minimum computer system for a typical mission is demonstrated. The configuration which is developed as a result of studies with the simulator is optimal with respect to the efficient use of computer system resources, i.e., the configuration derived is a minimal one. Other considerations such as increased reliability through the use of standby spares would be taken into account in the definition of a practical system for a given mission. Author

N73-11185*# Computer Sciences Corp., Huntsville, Ala. Field Service Div.
MEMORY INTERFACE SIMULATOR: A COMPUTER DESIGN AID
D. S. Taylor, T. Williams, and J. E. Weatherbee 6 Oct. 1972 25 p refs
(Contract NAS8-21805)
(NASA-CR-128996) Avail: NTIS HC $3.25 CSCL 09B

Results are presented of a study conducted with a digital simulation model being used in the design of the Automatically Reconfigurable Modular Multiprocessor System (ARMMS), a candidate computer system for future manned and unmanned space missions. The model simulates the activity involved as instructions are fetched from random access memory for execution in one of the system central processing units. A series of model runs measured instruction execution time under various assumptions pertaining to the CPU's and the interface between the CPU's and RAM. Design tradeoffs are presented in the following areas: Bus widths, CPU microprogram read only memory cycle time, multiple instruction fetch, and instruction mix. Author

N73-11186# Groupe de Recherches Ionospheriques, Paris (France).
PROCESSING OF DATA FROM THE FR-1 SATELLITE. PART 1: GENERAL FILE FLOWS IN THE VELOCITY RANGE OF 0.6> M>3.5 [SEICHTWASSERKANAL ZUR SIMULIERUNG VON GASSTROEMUNGEN IM GESCHWINDIGKEITSBEREICH 0,6>M>3,5]
L. Cairo 20 Jun. 1972 29 p refs In GERMAN
(GRI/NTP/100) Avail: NTIS HC $3.50

The analogy between a plane isentropic gas flow and a shallow water flow is described and the design of a hydraulic analogy facility discussed. The problems presented by analogy tests are reviewed. The concept of flowing water and immobile model, rather than still water and moving model is preferred because of simplification of the construction and easier and faster evaluation of flow patterns. An equality can be reached between Mach number and Froude number, but the equality of Reynolds numbers of the flows can only be realized by approximation. The application of the channel is limited to qualitative investigation.

Author (ESRO)

N73-11187# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
PROCESSING OF DATA FROM THE FR-1 SATELLITE. PART 2: THE VLF WAVE DATA [QESTION DES DONNEES DU SATELLITE FR-1. DEUXIEME PARTIE: LES DONNEES DE L'ONDE TBF]
L. Cairo 5 Jul. 1972 90 p refs In FRENCH 2 Vol.
(GRI/NTP/101) Avail: NTIS HC $6.50

The processing of very low frequency data transmitted from the French FR-1 satellite is described. The object of this processing was to file the measurements made according to the satellite passage order number and geographic location, and to select the measurements which satisfy the precise scientific criteria relating to local time, season, magnetic activity, etc.
Author (ESRO)

N73-11188# Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques, Brussels (Belgium). Section Construction Electrique.
COMPUTERIZED INFORMATION RETRIEVAL [TRAITEMENT PAR ORDINATEUR DE L'INFORMATION DOCUMENTAIRE]
Emile Peeters and Daniel Rosier Sep. 1972 84 p In FRENCH Sponsored by IRSIA
(CRIF-EL-5) Avail: NTIS HC $6.25
An information retrieval system, known as SESAM, was developed, based on an 8k byte minicomputer coupled to a microfilm reader/copier. The software of the system is described. The operations monitor which manages the system, allows for more than a document processing system. Information retrieval, including stored thesaurus and input operations, and the use of the system for setting up indexes are described, and costs are evaluated. Author (ESRO)

N73-11189# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.
DEBUGGING COMPUTER PROGRAMS. A SURVEY WITH SPECIAL EMPHASIS ON ALGOL
R. S. Scowen Jun. 1972 39 p refs
(NPL-NAC-21) Avail: NTIS HC $4.00
The problems of debugging computer programs and some of the tools which can simplify the task are considered. Ways in which compilers can aid the debugging of programs and ALGOL programs which can be used to determine the kinds of errors detected by an ALGOL compiler are described. Results of running the test programs on sixteen different compilers and results obtained from an error survey are given. Author (ESRO)

N73-11190# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et de ses Applications Spatiales.
INSTRUCTIONS OF USE OF AN IBM 1627 CURVE PLOTTER COUPLED TO AN IBM 1130 COMPUTER [MODE D'EMPLOI DU TRACEUR DE COURBES 1627 IBM COUPLE AVEC L'ORDINATEUR 1130 IBM]
G. Bouyssou May 1972 26 p In FRENCH
(LAAS-NT-SIS-72-T-09) Avail: NTIS HC $3.50
Subroutines for the use of the IBM 1627 X-Y plotter associated with an IBM 1130 computer are given.
Author (ESRO)

N73-11191# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et de ses Applications Spatiales.
PROGRAM FOR OPTIMIZING A CRITERION UNDER CONSTRAINTS USING THE GRADIENT PROJECTION METHOD, PART 2 [PROGRAMME D'EXTREMALISATION D'UN CRITERE SOUS CONTRAINTES PAR LA METHODE DU GRADIENT PROJETE, 2EME PARTIE]
T. Lefevre Feb. 1972 66 p refs In FRENCH
(LAAS-NI-CH-72-03) Avail: NTIS HC $5.50
HEATHER is a computer program for nonlinear optimization using the projection of the gradient vector. Improvements to this program are presented which will increase the performance, decrease the time to convergence and give the possibility to select one of two modes of convergence, convergence with an adaptive coefficient or with a constant iterative coefficient. The organigram of the program and the use of the subroutines are given. Author (ESRO)

N73-11192# ITT Electron Tube Div., Fort Wayne, Ind.
PATTERN THRESHOLD RECOGNITION DEVICE Quarterly Report, 1 Nov. 1971 - 31 Jan. 1972
S. Nevin and L. G. Wolfgang Jul. 1972 35 p
(Contract DAAB07-71-C-0226)
(AD-746246; ECOM-0226-3; QR-3) Avail: NTIS CSCL 09/1
The purpose of this contract is to further develop the pattern threshold recognition device by studying its electron optics and target. To make the device more practical, mechanical and processing improvements to extend the tube's lifetime are desired. During the report period the demountable electron-optical bench was used to evaluate the flood system used for earlier Pattern Recognition Threshold devices. Author (GRA)

N73-11193# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
LABORATORY CONVERSION AND STATE DESCRIPTION OF THE D-17B COMPUTER M.S. Thesis
Douglas J. Allen Jun. 1972 125 p refs
(AD-746008; GE/EE/72S-2) Avail: NTIS CSCL 09/2
The D-17B computer is a digital minicomputer that is used in the NSQ-10 Minuteman I missile guidance system. This system has been made available for reuse by qualifying agencies. Documentation concerning the procedures for converting the computer for general purpose use is being generated by the Minuteman Computer Users' Group. The report is addressed toward part of that effort. Before the conversion process is begun the computer may be tested to determine useability. An inexpensive forced-air cooling system will allow operation at ambient air temperatures up to 85 F. Fragmentary descriptions of the D-17B previously available are supplemented in this report by a description using the states of control flip-flops. This state description is useful as a study plan and a maintenance guide.
Author (GRA)

N73-11194# ITT Electron Tube Div., Fort Wayne, Ind.
PATTERN THRESHOLD RECOGNITION DEVICE Quarterly Report, 1 Aug. - 31 Oct. 1971
S. Nevin and L. G. Wolfgang Jun. 1972 19 p
(Contract DAAB07-71-C-0226)
(AD-745915; ECOM-0226-2; QR-2) Avail: NTIS CSCL 09/1
The purpose of this contract is to develop further the pattern threshold recognition device by studying its electron optics and target. To make the device more practical, mechanical and processing improvement to extend the tube's life expectancy are desired. A demountable electron-optical test bench has been designed, fabricated, and assembled. A processing schedule with rigorous outgassing of the tube's electrodes has been performed on two life test tubes, and the tubes have been evaluated.
Author (GRA)

N73-11195# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TEMPORAL PATTERN ANALYSIS USING MULTIDIMENSIONAL DISCRETE FOURIER TRANSFORMS M.S. Thesis
Gary H. Barber May 1972 139 p refs
(AD-745995; GGC/EE/72-1) Avail: NTIS CSCL 06/4
The purpose of the paper is to extend an existing two-dimensional Fourier transform model of the human visual system to include a temporal dimension. The first analysis considered used three dimensions, two representing space and the third representing time; it was found that by use of a temporal low-pass filter, periodic patterns could be separated from aperiodic. A subsequent analysis used only two dimensions, one representing a spatial dimension and the other time. By intermittent intensity variation upon the temporal pattern, a predicted psycho-perceptual effect was found in the model which was isomorphic to certain human perception phenomena. Further agreement with psychophysical data was found in the spatio-temporal relationship.
Author (GRA)

N73-11196# Naval Research Lab., Washington, D.C.
SIMULATION OF AADC (ADVANCED AVIONIC DIGITAL COMPUTER) PAGE REPLACEMENT ALGORITHMS Interim Report
William R. Smith Jul. 1972 14 p refs
(AD-746110; NRL-MR-2464) Avail: NTIS CSCL 09/2
Page replacement algorithms have been simulated to aid in making a choice from among those proposed for the Advanced Avionic Digital Computer (AADC) processing element. An E-2B program model and a statistical page reference generator were used to evaluate performance of these replacement schemes.
Author (GRA)

N73-11197# Tulane Univ., New Orleans, La. Systems Lab.
PROTOTYPE DEVELOPMENT OF AN AUTOMATED DATA ACQUISITION SYSTEM FOR A SINGLE CHANNEL AUTOANALYZER Final Report
Charles H. Beck Jul. 1972 78 p refs
(Contract DADA17-71-C-1019)
(AD-746264; TSL-1-72) Avail: NTIS CSCL 09/2

Instruments such as the AutoAnalyzer have increased productivity of data in clinical and research laboratories, but there is need to improve the efficiency of data analysis. The tedious process of manually performing waveform analysis from the AutoAnalyzer suggests the need for cost-effective automation. This report describes the work resulting from a research project which has demonstrated that modification of the Minuteman D17B Computer to provide for AutoAnalyzer waveform analysis is not only feasible but cost-effective. The D17B is a small general-purpose computer used in Minuteman I missiles. This report includes comprehensive documentation of related theory, system design, and programming required to accomplish data acquisition, control,and waveform analysis necessary to perform automated concentration analysis for a single-channel AutoAnalyzer. Author (GRA)

N73-11198# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR DETERMINING THE RELIABILITY CHARACTERISTICS OF COMPUTER COMPONENTS AND SUBSYSTEMS
Yu. A. Vasilenko and A. I. Vselyubskii 3 May 1972 14 p refs Transl. into ENGLISH from Prib. Sist. Avtomatiki (USSR), no. 13, 1970 p 62-67
(AD-747080; FTD-MT-24-2002-71) Avail: NTIS CSCL 09/2

A method is described for obtaining areas, in a system of coordinates of three parameters, in which the discrete functional elements tested operate with fixed reliability, and a device realizing the algorithm for the method suggested is described. The method consists of defining cross sections in the two dimensional space of two parameters with fixed values of the third parameter. The required number of cross sections with respect to the fixed parameter determines the desired area in the system of coordinates of the three parameters. Block diagrams are presented. Author (GRA)

N73-11199# Naval Medical Research Inst., Bethesda, Md.
A COMPUTER BASED PHYSIOLOGIC MONITORING SYSTEM Medical Research Progress Report No. 1
William E. Moritz, Paul A. VanAkkeren, and Richard G. Buckles 5 Jun. 1972 27 p
(AD-746872) Avail: NTIS CSCL 09/2

A versatile data acquisition and analysis system for use in physiologic research programs on both humans and animals is described. The system is capable of monitoring 16 channels of analog data, such as ECG and blood pressure, and 5 channels of digital data from radioisotope detectors. The transducers and signal conditioners required for a wide range of physiologic and environmental measurements are indicated. Real time analysis and monitoring of the data is provided by a variety of stored programs. Author (GRA)

N73-11200# Scientific Systems Services, Inc., Satellite Beach, Fla.
NAMI PHYSIOLOGICAL DATA ACQUISITION SYSTEM Final Report
Samuel F. Sears 13 Jun. 1972 10 p
(Contract N00014-69-C-0448; NR Proj. 105-557)
(AD-746874; SSS-FR001) Avail: NTIS CSCL 09/2

The Physiological Data Acquisition System software is designed to accomplish the acquisition, recording and logging of system data. The system software also provides for an operator communications facility which allows essential program control by the operator. Author (GRA)

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transitors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N73-11201 National Lending Library for Science and Technology, Boston Spa (England).
INFLUENCE OF EMITTER BASE CONTACT SEPARATION ON THE CURRENT AMPLIFICATION OF BIPOLAR TRANSISTORS
K. Rieder 27 Jul. 1972 16 p refs Transl. into ENGLISH from Solid State Electron. (Oxford), v. 14, Nov. 1971 p 1251-1258
(NLL-Trans-2861-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL Photocopy coupons

The diffusion of minority carriers from the emitter junction toward the base contact of bipolar transistors with very small dimensions cannot be neglected. The influence of this diffusion on base current and current amplification is demonstrated by means of analog model measurements. In order to calculate the diffusion toward the base contact an analytical approach is derived for the distribution of the minority carrier density between the emitter region and the base contact. There is reasonable agreement for a comparison between analytical predictions and analog simulations for typical structures and impurity distributions. Author

N73-11202# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
VISUAL CONTRAST SENSITIVITY WITH IDEAL IMAGE INTENSIFIERS
A. VanMeeteren and J. Boogaard [1972] 19 p refs
(IZF-1972-18) Avail: NTIS HC $3.00

In image intensifier tubes photons detected by the cathode, are converted into bright specks on a phosphor screen. To test the current fluctuation theory on vision with image intensifiers experimentally, the typical speck-images were simulated on a kinescope-screen. Foveal contrast sensitivity for sine wave gratings was measured with speck-density and speck-intensity as parameters. The spatial processing of speck-images proves to be the same as in normal unaided vision. Contrast sensitivity initially increases when the intensity of the specks is raised, but finally levels off. At this final level contrast sensitivity is proportional to the square root of the speck-density. The minimum speck-intensity, required for the final level depends upon the speck-density. The measurements enable a new determination of the quantum efficiency. Author

N73-11203# Research Inst. of National Defence, Stockholm (Sweden).
SOLENOID FOR OPERATING A VALVE
Thorvald Persson and Eskil Uten Sep. 1971 58 p ref In SWEDISH; ENGLISH summary
(FOA-2-C-2481-H5) Avail: NTIS HC $5.00

In the development of a pulsed electrically controlled pneumatic valve the operating force is produced by an electromagnet or solenoid. The magnetic force parameters are analyzed (without taking into account the optimum design) mainly with respect to geometrical dimensions. Also studied are the general parameters of the pulling force of the magnet, the existence of side forces, and especially the choice of precision and stiffness in the armature mounting. It is shown that the actual maximum force obtained exceeds appreciably that which can be expected from the above analysis. Author

N73-11204# Research Inst. of National Defence, Stockholm (Sweden).
WIDE BAND MICROWAVE COMPONENTS: SOME IMPRESSIONS FROM A STUDY VISIT TO GREAT BRITAIN, FRANCE AND WEST GERMANY, JUNE 1971
Sven Sundius and Carl-Goeran Lundqvist Aug. 1971 19 p In SWEDISH; ENGLISH summary
(FOA-3-A-3750-E6) Avail: NTIS HC $3.00

Information concerning methods of reproducing broadband

microwave components in Europe is reported. The reproduction methods requires such large investments that they could only be motivated in connection with development of larger microwave systems or mass production of sub-systems (e.g. Doppler radar). The European market for separate broadband components is small and mainly a secondary market for American component companies. In connection with system development by European firms there are by-products of certain types of wideband and components of improved performance superior in both price and capability to corresponding American equipment.
Author (GRA)

N73-11205*# Catholic Univ. of America, Washington, D.C.
ELECTROMAGNETIC WAVE ENERGY CONVERTER Patent Application
Robert L. Bailey, inventor (to NASA) Filed 27 Sep. 1972 19 p Sponsored by NASA
(NASA-Case-GSC-11394-1; US-Patent-Appl-SN-292698) Avail: NTIS HC $3.00 CSCL 10A

Electromagnetic wave energy is converted into electric power with an array of mutually insulated electromagnetic wave absorber elements each responsive to an electric field component of the wave as it impinges thereon. Each element includes a portion tapered in the direction of wave propagation to provide a relatively wideband response spectrum. Each element includes an output for deriving a voltage replica of the electric field variations intercepted by it. Adjacent elements are positioned relative to each other so that an electric field subsists between adjacent elements in response to the impinging wave. The electric field results in a voltage difference between adjacent elements that is fed to a rectifier to derive d.c. output power. The element pairs may be arranged in a two-dimensional array to provide power conversion of randomly polarized electromagnetic waves, such as sunlight.
NASA

N73-11206*# Ball Bros. Research Corp., Boulder, Colo.
TURNSTILE SLOT ANTENNA Patent Application
Robert E. Munson Filed 27 Sep. 1972 14 p Sponsored by NASA
(NASA-Case-GSC-11428-1; US-Patent-Appl-SN-292685) Avail: NTIS HC $3.00 CSCL 17B

A novel turnstile slot antenna is reported, the antenna being for and integral with a spacecraft having a substantially cylindrical body portion. The antenna comprises a circumferential slot about the periphery of the spacecraft body portion with an annular wave guide cavity defining a radial transmission line disposed within the spacecraft body portion behind and in communication with the circumferential slot. Feed stubs and associated transmission apparatus are provided to excite the annular cavity in quadrature phase such that an omnidirectional, circularly polarized, rotating radiation pattern is generated. The antenna ensures continuous telemetry and command coverage with the spacecraft.
NASA

N73-11207# Centre de Recherches de la Compagine Generale d'Electricite, Marcoussis (France). Div. des Applications Optiques.
CONCEPTUAL STUDY FOR A LASER TRANSPONDER ON BOARD THE PROBE SOREL Final Report
G. Courrier, P. Lebail, R. DeWavrechin, and J. Leroux 28 Jun. 1972 115 p refs Sponsored by ESRO
(ESRO-CR(P)-123) Avail: NTIS HC $7.75

The feasibility of using a laser transponder onboard the SOREL probe was investigated. Performance of CO2 laser and general characteristics of the onboard equipment such as mass, mass distribution and electrical power consumption were considered, as well as transmitter optics, frequency translator and signal processing. It is shown that a pulsed or CW laser detected by a heterodyne receiver is the best compromise for the down-link emitter receiver system. Amplitude, phase frequency and chirp modulation are discussed. It appears that amplitude modulation is the best solution if a spin reduction assembly can be used. If a good pointing accuracy cannot be achieved, the pulsed CO2 laser seems to be the only solution. The emission from the ground laser and from the weight penalty is rather high compared with the CW solution.
Author (ESRO)

N73-11208# Defence Research Information Centre, Orpington (England).
EXPERIMENTAL REFINEMENT OF CALCULATED FORMULAS FOR THE DISTRIBUTION OF POTENTIAL IN ELECTROCHEMICAL PROTECTION OF SHIPS FROM CORROSION
Y. L. Kuzmin Sep. 1972 10 p refs Transl. into ENGLISH from Tsentr. Nauchno-Issled., Inst. Tekhnol. Svdostr. (Leningrad), v. 8, no. 1, 1972 p 40-44
(DRIC-Trans-2877; BR-30257) Avail: NTIS HC $3.00

The calculated relationships of potential distribution over the underwater surface of ship hulls were established. The principal types of electrochemical protection, emphasizing the geometry and dimensions of the hull and the state of its paintwork, are also considered.
Author (ESRO)

N73-11209# Naval Electronics Lab. Center, San Diego, Calif.
PROCEEDINGS OF THE ARRAY ANTENNA CONFERENCE, VOLUME 1, PART 1
24 Feb. 1972 330 p refs Conf. held at San Diego, Calif., 22-24 Feb. 1972
(AD-744629; NELC-TD-155-Vol-1-Pt-1) Avail: NTIS CSCL 09/5

Contents: Phased arrays, A future; Vertical array of spirals for hemispheric coverage; Cylindrical and conical array investigations; A cylindrical phased-array antenna for air traffic control; Solid-state aircraft IFF transponder array; Solid-state phased arrays for satellite communications; Solid-state aperture despun antenna; Stripline strap-on antenna array; A new simulator technique for phased arrays; Decision-theoretic parallel processing arrays; An array synthesis technique for sidelobe control; Beam steering control system for a cylindrical array; Pattern analysis of wideband circular sector arrays; Images of antennas by spectrum analysis of microwave holograms; Analysis of antennas on aircraft; A 16-element frequency-locked bulk-effect array; Mair solid-state array.
GRA

N73-11210# Naval Electronics Lab. Center for Command Control and Communications, San Diego, Calif.
PROCEEDINGS OF THE ARRAY ANTENNA CONFERENCE, VOLUME 1, PART 2
24 Feb. 1972 215 p refs Conf. held at San Diego, Calif., 22-24 Feb. 1972
(AD-744630; NELC-TD-155-Vol-1-Pt-2) Avail: NTIS CSCL 09/5

Contents: Adaptive arrays for aircraft communication systems; Adaptive antenna compatibility with radar signal processing; Adaptive null steering for rf antenna arrays; A technique for generation of phase shifts required for circularly polarized and adaptive array antennas; Design and adaptive control of conformal arrays; Approximation of a conformal array with multiple, simultaneously excited planar arrays; A technique for control of conformal arrays; Synthesis techniques for conical arrays; Conical arrays; Some aspects of tem slot design in stripline; Wideband phase locking and phase shifting using feedback control of oscillators; Computer-aided design of microwave components for a linear phased array.
GRA

N73-11211# Harvard Univ., Cambridge, Mass. Cruft Lab.
MODIFIED DIPOLES. 2. NUMERICAL SOLUTIONS
Peter S. Kao Nov. 1971 102 p refs
(Contract F19628-68-C-0030; AF Proj. 5635)
(AD-745979; SR-13-Vol-2; AFCRL-72-0287) Avail: NTIS CSCL 09/5

An infinite set of algebraic equations was solved numerically for small cone angles. Comparisons were made between the modified conical antenna and its limiting biconical antenna which provides both an extrapolatory numerical check for the modified conical antenna with shrinking central sphere and an understanding of the underlying physical phenomena. Theoretical and experimental results are in very good agreement.
Author (GRA)

N73-11212# Collins Radio Co., Cedar Rapids, Iowa.
HIGH-STABILITY TEMPERATURE-COMPENSATED CRYSTAL OSCILLATOR STUDY, HSTCXO Interim Report, 1 Sep. 1971 - 29 Feb. 1972
Gayle Buroker, E. Jun. 1972 29 p
(Contract DAAB07-71-C-0136)
(AD-745914; ECOM-0136-02) Avail: NTIS CSCL 09/5

The objective of this study is the development of a high-

stability temperature compensated crystal oscillator (HSTCXO), capable of being produced in quantity for use in advanced SSB communications equipment. This report discusses progress in the second period, including additional retrace data on the frequency-temperature characteristics of crystals, the construction and coarse compensation of two HSTCXO models, and the fabrication and satisfactory test of MOS chips designed in the first period.
Author (GRA)

N73-11213# Cayuga Associates, Inc., Ithaca, N.Y.
X-BAND LSA LIMITED SPACE CHARGE ACCUMULATION (TRANSMITTER SOURCES) Interim Technical Report, 15 Oct. 1971 - 15 Apr. 1972
Joseph S. Bravman, David W. Woodard, and Lester F. Eastman Jul. 1972 38 p refs
(Contract DAAB07-72-C-0041; DA Proj. 1S6-62705-A-056)
(AD-746655; ECOM-0041-1) Avail: NTIS CSCL 09/1

Specific attention during this program was centered on GaAs wafer development, diode construction, and resonator design. In addition, a pulse modulator was constructed to aid in the high duty cycle testing. Such modulators are recommended as best suited for system designs incorporating high power LSA sources.
Author (GRA)

N73-11214# Sprague Electric Co., North Adams, Mass.
HIGH ENERGY CAPACITORS FOR MODERATE REPETITION RATE Final Report, 30 Oct. 1970 - 29 Jan. 1972
Conrad Halberg and Herbert Rice May 1972 105 p
(Contract DAAB07-71-C-0049; DA Proj. 1S6-62705-A-057)
(AD-746991; A119-51; ECOM-0049-F) Avail: NTIS CSCL 09/1

Capacitors of six designs were designed, constructed and measured for various electrical characteristics. Two designs were constructed in three variations and further discharge life tested for a total of 10,000,000 charge-discharge cycles or until failure. Capacitors were constructed and discharge life tested for 50,000,000 charge-discharge cycles or until failure. All six capacitors met the contract requirements of delivering 12 joules of energy at 900 V and weighing less than six ounces.
Author (GRA)

N73-11215# Sperry Rand Research Center, Sudbury, Mass.
HIGH-EFFICIENCY SOLID STATE MICROWAVE AMPLIFIER Final Report, 4 Jun. 1971 - 4 Mar. 1972
Martin I. Grace, Harry Kroger, Curtis N. Potter, and Jacques Telio Griffiss AFB, N. Y. RADC Jun. 1972 83 p refs
(Contract F30602-71-C-0294)
(AD-747050; SRRC-CR-72-4; RADC-TR-72-101) Avail: NTIS CSCL 09/5

The report describes the design and development of a wideband TRAPATT amplifier in a microstrip configuration. This development was guided by both the original development of a coaxial wideband TRAPATT amplifier as well as the concurrent development of an analytical theory for the TRAPATT amplifier. Performance of microstrip amplifier was found to be essentially the same as for coaxial amplifiers: 8dB gain over an 8% bandwidth. S-band TRAPATT oscillators were demonstrated with 10 W output for 20 microsec. pulses. The phase response of TRAPATT amplifiers was shown to be relatively independent of the particular choice of active devices selected from a given run of diodes.
Author (GRA)

N73-11216# Lincoln Lab., Mass. Inst. of Tech., Lexington.
UHF ACTIVE FILTER MANIFOLDS Final Report, May 1970 - Sep. 1971
Robert S. Forman and Michael Moore Apr. 1972 47 p refs
Prepared by Spectrum Microwave Corp.
(Contract F19628-70-C-0230; AF Proj. 627A)
(AD-747012; ESD-TR-72-182; SMC-1008-F) Avail: NTIS CSCL 09/5

A high Q Active Filter channel has been developed for application in a miniature thirty two channel UHF Filter Manifold covering the frequency range 390 to 430 MHz. A unique and versatile design concept using microwave gyrator techniques was applied to this development in two phases. The first phase involved demonstrating the electrical performance of the gyrator active filter channel, and the second phase was concerned with the miniaturization and packaging of the filter channel.
Author (GRA)

N73-11217# Air Force Weapons Lab., Kirtland AFB, N.Mex.
AN APPROXIMATE DISTRIBUTION FOR RESISTANCE CAPACITANCE INTEGRATED CHI-SQUARED NOISE Technical Report, May - Jun. 1972
D. C Niemoller Jul. 1972 20 p refs
(AF Proj. 5791)
(AD-747208; AFWL-TR-72-116) Avail: NTIS CSCL 09/5

A generalization of the Satterthwaite approximation is used to approximate the probability distribution of the output of a resistance-capacitance integrator with Chi-square noise input. General relations are also derived which may be applied to other filter characteristics.
Author (GRA)

N73-11218# Army Electronics Command, Fort Monmouth, N.J.
THERMIONIC EMISSION FROM OXIDE-COATED CATHODES AT LOW TEMPERATURES
Bernard Smith Jun. 1972 27 p refs
(DA Proj. 1H6-62705-A-055)
(AD-747319; ECOM-3585) Avail: NTIS CSCL 09/1

The preparation and emission analysis of a cathode coating which uses Kodak Thin-Film Resist (KTFR) as the suspension rather than the commonly used amyl acetate is discussed. This suspension is being investigated to determine its potential as a low-temperature thermionic cathode and its merits for use in an internal program titled Coplanar Thermionic Devices. The development of the necessary photoetch techniques using this mix so that well defined cathode patterns could be delineated is also outlined.
Author (GRA)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

N73-11219*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
INCOMPLETE STATE FEEDBACK FOR SYSTEMS WITH PARAMETER UNCERTAINTY AND RANDOM DISTURBANCES
Sibnath Basuthakur Aug. 1972 118 p refs
(Grant NGL-07-002-002)
(NASA-CR-129180; TR-72-6) Avail: NTIS HC $8.00 CSCL 09C

A unified design philosophy is presented for limited state feedback control problems with parameter uncertainty for both deterministic and stochastic problems. Two approaches are considered: linear compensator for the deterministic problem with parameter uncertainty, and for the single input-single output system with parameter uncertainty, a model on order equal to that of the system less the number of zeroes. The limitations of these approaches are discussed along with suggestions for further research.
F.O.S.

N73-11220*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
SURVEY OF ADAPTIVE CONTROL USING LIAPUNOV DESIGN
D. P. Lindorff and R. L. Carroll Sep. 1972 9 p refs
(Grant NGL-07-002-002)
(NASA-CR-129175; TR-72-7) Avail: NTIS HC $3.00 CSCL 09C

A survey was made of the literature devoted to the synthesis of model-tracking adaptive systems based on application of Liapunov's second method. The basic synthesis procedure is introduced and a critical review of extensions made to the theory since 1966 is made. The extensions relate to design for relative stability, reduction of order techniques, design with disturbance, design with time variable parameters, multivariable systems, identification, and an adaptive observer.
Author

N73-11221# Helsinki Univ. of Technology, Otaniemi (Finland).
A NEW SYNTHESIS METHOD FOR BRANCH GUIDE

DIRECTIONAL COUPLERS
Martti Valtonen 1972 24 p refs
(APS-EI-30; ISBN-951-666-004-5) Avail: NTIS HC $3.25

A narrow-band equivalent circuit for a two-port network consisting of cascaded, unit length, lossless transmission lines and lumped or distributed, lossless shunt elements between them was obtained by replacing the shunt elements by imaginary conductances. This type of network model may be used in the design of both symmetrical and asymmetrical, branch guide directional couplers. The theoretical performance of the couplers at low coupling levels is in good agreement with earlier results. An optimum termination impedance ratio giving the minimum VSWR level for fixed directivity and coupling levels is given.
Author

N73-11222*# Alabama Univ., University. Bureau of Engineering Research.
MICROSTRIP TECHNOLOGY AND ITS APPLICATION TO PHASED ARRAY COMPENSATION
James E. Dudgeon and William D. Daniels 21 Jan. 1972 88 p refs
(Contract NAS8-25894)
(NASA-CR-123819; TR-2) Avail: NTIS HC $6.50 CSCL 09E

A systematic analysis of mutual coupling compensation using microstrip techniques is presented. A method for behind-the-array coupling of a phased antenna array is investigated as to its feasibility. The matching scheme is tried on a rectangular array of one half lambda 2 dipoles, but it is not limited to this array element or geometry. In the example cited the values of discrete components necessary were so small an L-C network is needed for realization. Such L-C tanks might limit an otherwise broadband array match, however, this is not significant for this dipole array. Other areas investigated were balun feeding and power limits of spiral antenna elements.
Author

N73-11223# Illinois Univ., Urbana. Antenna Lab.
ANALYSIS OF MICROSTRIP TRANSMISSION LINES
Tatsuo Itoh and Raj Mittra Jun. 1972 125 p refs
(Grants DA-ARO(D)-31-124-71-G77; NSF GK-15288; NSF GK-25074)
(AD-746059; UIAL-72-5; UILU-ENG-72-2543) Avail: NTIS CSCL 09/1

In this work a number of semirigorous and numerical techniques are presented for analyzing the microstrip transmission line configurations. The methods of quasi-TEM as well as hybrid-mode analyses are presented in some detail. A discussion of the higher-order modes in such transmission lines is also included. In addition to analyzing the uniform line configurations, the problem of evaluating the effect of losses, end loading, etc., are examined and methods for handling these problems are discussed.
Author (GRA)

N73-11224# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MICROELECTRONICS
S. N. Gavrilov and S. M. Nikulin 6 May 1972 137 p refs Transl. into ENGLISH from Massovaya Radio Biblioteka (USSR), 1970 p 1-79
(AD-746715; FTD-MT-24-1260-71) Avail: NTIS CSCL 09/5

The document deals primarily with radio electronics, printed circuitry, miniaturization, microminiaturization, information processing methods and related aspects of Radio Electronic Equipment. It points out the advantages of microminiaturization from the stand-point of the savings in cost, weight, overall size and its utility.
Author (GRA)

N73-11225# Texas Univ., Austin. Electronics Research Center.
TEXAS BIANNUAL OF ELECTRONICS RESEARCH Final Report, 1 Apr. - 30 Sep. 1971
Erwin A. Dougal, D. G. Lainiotis, and O. M. Friedrich, Jr. 15 Nov. 1971 311 p refs
(Contract F44620-71-C-0091; AF Proj. 4751)
(AD-745968; AFOSR-72-0473TR; Rept-14) Avail: NTIS CSCL 09/3

Research topics in progress, recent findings, and future plans in the areas of bio-medical electronics; information; plasma and quantum electronics; solid state electronics; and acoustics and radio sciences are presented.
Author (GRA)

N73-11226# Electrophysics Corp., Nutley, N.J.
VLF-LF SHIFT FSK ANTENNA FEED NETWORKS Final Report, Sep. 1970 - Aug. 1971
L. M. Vallese Mar. 1972 32 p refs
(Contract N00014-71-C-0043)
(AD-746119) Avail: NTIS CSCL 09/5

The problem of broadbanding VLF and LF antennas for wide shift FSK modulation has been solved by recourse to static feed networks, which exhibit either two separate passbands centered at the mark and at the space frequency respectively, or a single wide passband extending over the frequency shift. Several configurations of one-port and of two-port networks have been developed: these exhibit minimum number of elements, with values that are economically realizable. The new antenna feed networks could be applied to existing antenna installation without excessive modifications.
Author (GRA)

N73-11227# Massachusetts Inst. of Tech., Cambridge. Dept. of Electrical Engineering.
SOME CONTROL AND COMMUNICATION ASPECTS OF STOCHASTIC SYSTEMS M.S. Thesis
Chadwick H. Carpenter, Jr. May 1972 138 p refs
(Grants AF-AFOSR-2273-72; NSF GK-25781; AF Proj. 9769)
(AD-746679; ESL-R-481; AFOSR-72-1338TR) Avail: NTIS CSCL 12/1

The thesis considers the control of linear, noisy systems with two controllers. Two major areas are treated: cooperative control of a partially decentralized system by two controllers and control and intersystem communication for a coupled system.
Author (GRA)

N73-11612* Wayne State Univ., Detroit, Mich.
THE INVERSE SCATTERING PROBLEM FOR TRANSMISSION LINES
Irvin Kay *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 16 p (For availability see N73-11585 02-19)
CSCL 09C

N73-11619* California Univ., San Diego.
THE BACKUP-GILBERT METHOD AND ITS APPLICATION TO THE ELECTRICAL CONDUCTIVITY PROBLEM
Robert L. Parker *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 8 p (For availability see N73-11585 02-19)
CSCL 09C

N73-11625* Bell Telephone Labs., Inc., Murray Hill, N.J.
TRANSMISSION LINE INVERSION AND SYNTHESIS FROM THE POINT OF VIEW OF TRANSIENT RESPONSE
M. M. Sondhi *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 7 p refs (For availability see N73-11585 02-19)
CSCL 09C

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N73-11228 Ernst-Mach-Inst., Freiburg (West Germany).
THEORETICAL AND EXPERIMENTAL STUDIES ON THE DRIVE OF A SHOCK PRESSURE SIMULATOR OF LARGE CROSS SECTION [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ZUM ANTRIEB EINES DRUCK-STOSSIMULATORS GROSSEN QUERSCHNITTS]
Hans-Otto Amann May 1972 48 p refs In GERMAN
(Rept-2/72) Avail: Issuing Activity

Theoretical and experimental investigations were carried out on the application of rechargeable compressed air bottles to the generation of shock waves in large diameter shock tunnels. Three computation methods were developed. The results are represented

in diagrams and compared to small-scale experiments. Two examples are given to demonstrate the application of the computation methods. The methods used are based on: steady jet flow combined with several wave diagrams, shock tube with wide drive tube, combined with the Chisnell formula, and shock tube with wide drive tube, combined with the steady-state method. It is shown that the calculations lead to a fast and sufficient estimation of the necessary gas dynamic and geometric data for a shock wave simulator. Author (ESRO)

N73-11229*# Lockheed Missiles and Space Co., Huntsville, Ala.
FEASIBILITY OF WAKE VORTEX MONITORING SYSTEMS FOR AIR TERMINALS Final Report, Jan. 1971 - Jul. 1972
D. J. Wilson, K. R. Shrider, and T. R. Lawrence Aug. 1972 234 p refs
(Contract NAS8-26668)
(NASA-CR-123921; LMSC-HREC-D225936; HREC-6668-1) Avail: NTIS HC $3.75 CSCL 01E

Wake vortex monitoring systems, especially those using laser Doppler sensors, were investigated. The initial phases of the effort involved talking with potential users (air traffic controllers, pilots, etc.) of a wake vortex monitoring system to determine system requirements from the user's viewpoint. These discussions involved the volumes of airspace to be monitored for vortices, and potential methods of using the monitored vortex data once the data are available. A subsequent task led to determining a suitable mathematical model of the vortex phenomena and developing a mathematical model of the laser Doppler sensor for monitoring the vortex flow field. The mathematical models were used in combination to help evaluate the capability of laser Doppler instrumentation in monitoring vortex flow fields both in the near vicinity of the sensor (within 1 kilometer and at long ranges(10 kilometers). Author

N73-11230# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
LONGITUDINAL SPLITTING OF A WIND TUNNEL MOVING GROUND BELT AND ITS EFFECT ON A JET FLAP MODEL
A. Berg Jan. 1972 34 p refs Sponsored by Natl. Res. Council of Canada
(UTIAS-TN-173) Avail: NTIS HC $3.75

An experiment undertaken to examine the effects of variation in the geometry of moving ground boards used in the testing of high lift aircraft models in wind tunnels is presented. A high lift STOL model with a blown flap was designed, constructed, and tested in the NRC 3 x 3 pilot tunnel in Ottawa. It was found that if the moving ground belt was split into two pieces, and the gap was of the order of the fuselage width or smaller, that no effect was observed on the tested aerodynamic properties of CL, CD, NT. However, if the split or dead band was increased to a width much greater than that of the fuselage, significant decreases in CL were observed. It was also found that the belt velocity used in the test required only to be matched to the tunnel speed to within + or - 8% to ensure no error in the measured aerodynamic parameters. Author

N73-11231# Radcliffe Observatory, Pretoria (South Africa).
[HISTORY OF RADCLIFFE OBSERVATORY, OXFORD, AND RADCLIFFE OBSERVATORY, PRETORIA, 1772 - 1972]
A. D. Thackeray 1972 58 p refs Original contains color illustrations
Avail: NTIS HC $5.00

The history of the Radcliffe Observatory at Oxford includes descriptions of professional personnel and their contributions to astronomical research from 1772 to the present period. Also briefly outlined are instrumentation, work programs, and the building of a second observatory in Pretoria. G.G.

N73-11232# Toronto Univ. (Ontario).
THE UTIAS PRECIPITATION WIND TUNNEL
A. Harting Sep. 1972 64 p refs
(UTIAS-TN-181) Avail: NTIS HC $5.24

A description is given of the design, construction, and calibration of a closed circuit wind tunnel, specially designed for studying the aerodynamic behavior of precipitation (rain or snow) falling in a side wind blowing about buildings or other structures. The tunnel has a test section of 3-1/2 ft. by 16 ft., and a maximum wind velocity of about 10 ft/sec. The particles selected to simulate rain and snow were spherical glass beads having diameters in the 20 to 150 micron range. A review is given of the current knowledge of the aerodynamics of precipitation. Author

N73-11233# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
INITIAL CALIBRATION AND PHYSIOLOGICAL RESPONSE DATA FOR THE TRAVELLING-WAVE SONIC-BOOM SIMULATOR
Richard Carothers Aug. 1972 91 p refs
(UTIAS-TN-180) Avail: NTIS HC $6.75

The construction of two sonic boom simulators at the University of Toronto, Canada is discussed. The simulators are used to determine the effects of sonic booms on the human heart. The details of the construction of the facility are presented. The characteristics of the shock waves produced by the facility are analyzed. The effect of boundary layer growth on the particle velocity at various distances is analyzed. Physiological response data concerning heart action in response to sonic booms are presented as block diagrams. Author

N73-11234*# Army Engineer Waterways Experiment Station, Vicksburg, Miss. Mobility and Environmental Div.
OPERATIONS AND MAINTENANCE MANUAL FOR A SCALE-MODEL LUNAR ROVING VEHICLE
A. S. Lessem Apr. 1972 60 p refs
(NASA Order H-72026-A)
(NASA-CR-129176; AEWES-Misc-Paper-M-72-3) Avail: NTIS HC $5.00 CSCL 13F

A one-sixth scale model of the lunar roving vehicle used in the Apollo 15 mission was built and instrumented to conduct model studies of vehicle mobility. The model was free running under radio control and was equipped with a lightweight telemetry transmitter that allowed 16 channels of data to be gathered simultaneously. String payout and fifth-wheel devices were developed to measure vehicle velocity. Other real-time measurements included wheel torque, wheel speed, center-of-gravity accelerations, and steering forces. Calibration, operations, and maintenance procedures were worked out. Details of the development of the instrumentation, its maintenance, and some of the problems encountered, are recorded serve as a preliminary operations and maintenance manual for this specific model. In addition, information regarding soil processing and testing that may be useful to NASA personnel planning mobility research with the model in soil is furnished. Author

N73-11235# National Aviation Facilities Experimental Center, Atlantic City, N.J.
EVALUATION OF HIGH-ACTIVITY LEVEL TOWER CAB Final Report, Sep. 1971 - Jul. 1972
J. Roy Bradley, Jr. Oct. 1972 57 p
(FAA Proj. 144-170-07(X))
(FAA-NA-72-63; FAA-RD-72-111) Avail: NTIS HC $5.00

The development of operator's consoles, lighting systems, and equipment to produce an efficient airport tower environment is discussed. The equipment included in the tower mockup is described and the results of performance tests are presented. It was concluded that the tower mockup met all the requirements for an efficient and comfortable operating environment. Author

N73-11236*# Houston Univ., Tex.
CONCEPTUAL DESIGN OF A LUNAR COLONY Report on NASA/ASEE Engineering Systems Design Inst.
Charles Dalton, ed. and Edward Hohmann, ed. (Calif. State Polytech. Coll.) Sep. 1972 529 p refs Inst. held summer 1972; sponsored by Houston Univ., Rice Univ., and NASA. Manned Spacecraft Center
(Grant NGT-44-005-114)
(NASA-CR-129164) Avail: NTIS HC $28.50 CSCL 06K

A systems engineering study is presented for a proposed lunar colony. The lunar colony was to grow from an existent, 12-man, earth-dependent lunar surface base and was to utilize lunar resources, becoming as earth-independent as possible. An in-depth treatment of some of the aspects of the lunar colony was given. We have found that the use of lunar resources is feasible for oxygen production (both for breathing and for space tug fuel), food production, and building materials. A program is

outlined for recycling waste materials developed at the colony as well as a full program for growth and research activity of the colony to a level of 180 colonists. Recommendations for the lunar colony are given. Author

N73-11237*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALIBRATION OF LEWIS HYPERSONIC TUNNEL FACILITY AT MACH 5, 6, AND 7
Richard R. Cullon and Erwin A. Lezberg Washington Nov. 1972 32 p refs
(NASA-TN-D-7100; E-6928) Avail: NTIS HC $3.00 CSCL 14B

Results of the initial calibration tests and a description of this true simulation facility are presented. Facility nozzles were calibrated over a range of stagnation pressure and temperature from 140 to 700 newtons per square centimeter and 1100 to 1750 K. The Reynolds number varied from 1.77 million to 7.44 million per meter. Mach numbers in the inviscid core of the three nozzles were 5.17 plus or minus 0.03, 6.05 plus or minus 0.02, and 7.25 plus or minus 0.08. Usable core diameters at the nozzle exit plane varied from 69 to 86 centimeters. True simulation with these performance capabilities and the test section size presently make this a unique operating facility. Author

N73-11238# European Space Research and Technology Center, Noordwijk (Netherlands).
THE COMPONENT TEST FACILITY OF THE ESTEC MAGNETIC TEST FACILITIES
F. G. Heinlein Paris ESRO Jun. 1972 29 p refs
(ESRO-TM-152-ESTEC) Avail: NTIS HC $3.50

The component test facility combines coils for earth-field compensation and magnetization/demagnetization with a difference magnetometer sensor and a manipulator. The coil system is within a cubic frame approximately 1 m on a side. Two different coil configurations are employed. The main power supplies are located in the service building and are remotely controlled from the laboratory building, which houses the coils and is located about 100 m away. The facility was designed and manufactured at ESTEC. A detailed account is given of the important criteria and parameters related to the facility.
Author (ESRO)

N73-11239# Syracuse Univ. Research Corp., N.Y. Policy Inst.
ENVIRONMENTAL RESEARCH LABORATORIES IN THE FEDERAL GOVERNMENT: AN INVENTORY, VOLUME 1 Final Report
Albert H. Teich, Philip H. Howard, and LeeAnn Sumnicht Sep. 1971 366 p refs
(Grant NSF GI-35)
(PB-209751) Avail: NTIS HC $6.00 CSCL 14B

A detailed description of the structure, capabilities, and current research activities of virtually all Federal Government R and D laboratories engaged in environmental studies is reported. Information shown for each of the approximately 170 laboratories includes: name; agency; location; mailing address and telephone number; director; type of installation; mission or main function; extent of environmental research; budget (for past five years, if available); unusual equipment or facilities; number of reports and publications; list of meetings and symposia hosted; list of training programs hosted; etc. Author (GRA)

N73-11240# Syracuse Univ. Research Corp., N.Y. Policy Inst.
ENVIRONMENTAL RESEARCH LABORATORIES IN THE FEDERAL GOVERNMENT: AN INVENTORY, VOLUME 2 Final Report
Albert H. Teich, Philip H. Howard, and LeeAnn Sumnicht Jul. 1971 508 p refs
(Grant NSF GI-35)
(PB-209752) Avail: NTIS HC $6.00 CSCL 14B

The report concludes an inventory listing of the structure, capabilities, and current research facilities of virtually all Federal Government R and D laboratories engaged in environmental studies. The inventory from DOD/USA through DOT/USCG is presented. GRA

N73-11241# Naval Research Lab., Washington, D.C.
PROTECTIVE COVER FOR FLUSH-DECK NOZZLES ON AIRCRAFT CARRIER FLIGHT DECKS Interim Report
H. B. Peterson and R. L. Gipe Jul. 1972 18 p refs
(NRL Proj. C05-19203)
(AD-746841; NRL-MR-2471) Avail: NTIS CSCL 06/17

A flexible cover for use with the Type S flush-deck nozzle installed on aircraft carrier flight decks has been evaluated. The cover was cut from a sheet of silicone rubber and affixed to the nozzle with a screw fitting into the hole normally provided for insertion of the center plug. The purpose of the cover is to provide protection against entry of foreign material with consequent clogging of the orifice. It was found that the cover, which could be readily installed on all existing nozzles, did not interfere with the normal discharge pattern characteristics. Also, the cover is capable of providing a built-in masking when the flight deck is anti-skid coated because a typical epoxy coating did not adhere to the rubber. The rubber material is stable up to 800F, and above this temperature it burns to a harmless powdery ash without melting. No performance data were obtained on the cover's ability to resist mechanical damage from vehicle and aircraft movement. Author (GRA)

N73-11242# Air Force Systems Command, Wright-Patterson AFB, Ohio.
REPAIR OF SYNTHETIC AIRPORT COATINGS
E. M. Dashevskii and A. P. Parfenov 24 Mar. 1972 263 p refs Transl. into ENGLISH of the book "Remont Izkusstvennykh Aerodromnykh Pokrytii" Moscow, Izd-vo Transport, 1969 p 1-190
(AF Proj. 1256)
(AD-746718; FTD-MT-24-1914-71) Avail: NTIS CSCL 01/5

An artificial airport surface complex is a very expensive installation. Thus prolonging the service life or increasing the inter-repair use period of this structure is a very important problem from the economic viewpoint. No less important is ensuring safety during takeoff, landing, and taxiing of aircraft during the whole course of use of the airport by creating conditions promoting reduction in the operational loads on the aircraft as a whole and on its individual units. On the basis of the generalization of Soviet experience and the study of the foreign literature, the causes of the appearance of deformations in the basic types of artificial airport surfaces and the most effective methods of repairing them with the use of new structural materials are examined. Author (GRA)

N73-11243# Naval Postgraduate School, Monterey, Calif.
PRODUCTION TEST FACILITIES FOR TURBOJET AND TURBOFAN ENGINES: 1975 - 1995
David L. Bailey and Philip W. Toner May 1972 83 p refs
(AD-745877; NPS-57BA72061A) Avail: NTIS CSCL 14/2

A review is made of test cell design options in order to identify characteristics of jet engine test facilities to be constructed in the 1970's and designed to be operable for a minimum of twenty years. The necessity of providing replacements for many current facilities is documented, and the factors which will ensure future production capability and economic feasibility are detailed. Present turbine engines are reviewed and projections of future engines and aircraft are made. A confidential supplement is available for qualified recipients. Author (GRA)

N73-11244# Nielson (John P.), Durham, N.H.
STRUCTURAL EVALUATION OF CELLULAR PLASTIC AS A BASE COURSE MATERIAL FOR EXPEDIENT PAVEMENTS Technical Report, May - Nov. 1971
John P. Nielsen and Charles B. Schriver Mar. 1972 78 p refs
(Contract F29601-71-C-0083; AF Proj. 683M)
(AD-747048; AFWL-TR-71-134) Avail: NTIS CSCL 01/5

The report is a study concerned with the development and structural analysis of a new pavement concept for military expedient pavements. Advanced tactical mobility concepts require a non permanent, quickly constructed and easily repaired airfield pavement system which can successfully withstand a limited number of aircraft coverages. Such pavements are referred to as expedient pavements. The concept presented considers the use of plastics as a construction material for expedient pavements. These all-plastic pavements consist of a thin (0.5-inch) wearing course fabricated from a tough and durable fiberglass reinforced polyester having very high strength properties.

and a cellular plastic base course placed directly upon the subgrade. For purposes of the study, rigid polyurethane was used as the base course material simply as a means of providing strength data for the structural analyses. The study demonstrates the feasibility of the concept of an all plastic system for expedient pavements. Author (GRA)

N73-11245# Army Mobility Equipment Research and Development Center, Fort Belvoir, Va.
FORWARD AREA REFUELING EQUIPMENT (FARE) Technical Report, Jan. 1969 - Jul. 1971
Wayne E. Studebaker and James E. Christopher Apr. 1972 180 p refs
(DA Proj. 1J6-64717-DL-41)
(AD-746249; USAMERDC-2029) Avail: NTIS CSCL 15/5

The U.S. Army has sponsored the development of the Forward Area Refueling Equipment (FARE) in response to an Army requirement for a simple to operate, lightweight, air transportable set to refuel helicopters in extreme forward areas. The FARE, intended primarily for refueling helicopters in forward area operations, is transportable by Army utility or cargo helicopters either as internal cargo or as a sling load. Emplacement of the equipment can be accomplished by two men without the use of materials handling equipment. Author (GRA)

N73-11246# Oregon State Univ., Corvallis. Science Research Inst.
A RESTRAINT SYSTEM FOR SQUIRREL MONKEYS Technical Report, 1 Jul. 1967 - 30 Aug. 1970
F. N. Dost, D. E. Johnson, and C. H. Wang Wright-Patterson AFB, Ohio AMRL May 1972 12 p refs
(Contract F33615-67-C-1787; AF Proj. 7163)
(AD-746661; AMRL-TR-71-126) Avail: NTIS CSCL 14/2

Details of design and construction of a laboratory animal restraint chair, are given. Materials of construction are acrylic plastic, nylon, aluminum and stainless steel. All edges contacting the animal are fire polished. Dimensions of the components are tabulated. Author (GRA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N73-11247 Engineering Sciences Data Unit, London (England).
INTRODUCTORY MEMORANDUM ON THE VISCOSITY OF LIQUIDS AND THE CLASSIFICATION OF LUBRICATING OILS
1 Oct. 1968 27 p refs Supercedes ESDU-65001 Sponsored by Inst. of Mech. Engr.
(ESDU-68036; ESDU-65001) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Factors are presented for converting viscosity data obtained from the literature into common working units. The effects of temperature and pressure on viscosity are discussed, as well as how approximate values of viscosity may be estimated, particularly in the absence of direct data. Major sources of numerical data on viscosity are indicated, and information is given on a number of commonly used classification systems for lubricating oils, based on viscosity and the effect of temperature on viscosity. Author

N73-11248 National Lending Library for Science and Technology, Boston Spa (England).
IMPACT OF A SUPERSONIC JET UPON A SURFACE
A. Ya. Sagomonyan Sep. 1972 9 p ref Transl. into ENGLISH from Vest. Mosk. Univ., ser. 1 (Moscow), no. 6, 1966 p 98-103
(NLL-RTS-7551) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.90; 3 NLL photocopy coupons

The normal impact of a supersonic gas jet upon a solid surface was examined. Particular attention was given to the shape and position of the shock wave. Consideration was also given to mean parameter values of subsonic motion of the gas between the shock wave and the surface. The gas was assumed to be ideal and calorically perfect. Author

N73-11249 National Lending Library for Science and Technology, Boston Spa (England).
MODERN METHODS AND EQUIPMENT FOR THE ACCURATE MEASUREMENT OF LIQUID AND GAS FLOWS
A. A. Tupichenkov 1972 26 p refs Transl. into ENGLISH of VNIIFTRI, Kazan, Report
(NLL-Trans-45-(3958.4)) Avail: Natl. Lending LIbrary, Boston Spa, Engl.: 3 NLL photocopy coupons

Methods and equipment for the measurement of liquid and gas flows are discussed. The equipment is described under three categories: (1) scientific and experimental units for conducting research, (2) calibration instruments for adjusting work units during development and state tests, and (3) checking units and standard instruments for the operational control of the state of development of working instruments. The class of unit depends on the accuracy of the measurement of the quantity of the liquid passed during the experiment, calibration or test. Author

N73-11250 Engineering Sciences Data Unit, London (England).
FLUID FORCES AND MOMENTS OF FLAT PLATES
Sep. 1970 20 p refs Revised Supersedes ESDU-Aero-W.00.01.02 Sponsored by Roy. Aeron. Soc., Inst. Chem. Engr., Inst. Struct. Engr., and Inst. Mech. Engr.
(ESDU-70015-Amend-A; ESDU-Aero-W.00.01.02) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Information is presented on the normal forces and center of pressure positions for thin flat plates of various shapes. The data are presented in terms of nondimensional mean force coefficients, which are used in conjunction with predetermined free stream velocities (e.g. wind velocity) to determine the actual forces acting on a plate. The data are predominantly for isolated plates in uniform flows. However, data for surface-mounted rectangular plates are given, as well as a method of allowing for the effects of a shear flow (i.e. an approach flow with a velocity gradient, such as a ground boundary layer). Author

N73-11251*# Iowa State Univ. of Science and Technology, Ames. Engineering Research Inst.
NUMERICAL CALCULATIONS OF FLOW FIELDS Progress Report, 1 Jul. 1971 - 30 Jun. 1972
Dale M. Anderson and Jerry Vogel 30 Jun. 1972 121 p refs
(Grant NGR-16-002-029)
(NASA-CR-129178; ERI-72193) Avail: NTIS HC $8.25 CSCL 20D

The solutions to the equations of motion for inviscid fluid flow around a pointed elliptic cone at incidence are presented. The numerical method used, MacCormack's second order preferential predictor-corrector finite difference approximation, is applied to the fluid flow equations derived in conservation-law form. The entropy boundary condition, hitherto unused for elliptic cone problems, is investigated and compared to reflection boundary condition solutions. The stagnation streamline movement of the inclined elliptic cone is noted and surface pressure coefficients are plotted. Also presented are solutions for an elliptic cone and a circular cone at zero incidence and a circular cone at a small angle of attack. Comparisons are made between these present solutions and previously published theory. Author

N73-11252*# Vanderbilt Univ., Nashville, Tenn.
AN ANALYTICAL INVESTIGATION OF THE IMPINGEMENT JETS ON CURVED DEFLECTORS
N. M. Schnurr, J. W. Williamson, and J. W. Tatom [1972] 41 p refs
(Grant NGR-43-003-034)
(NASA-CR-129136) Avail: NTIS HC $4.25 CSCL 20D

Numerical solutions are obtained for the cases of straight circular jets impinging on axisymmetric curved surfaces and plane jets impinging symmetrically on two-dimensional curved surfaces. These geometries are representative of some types of thrust reversers for transport aircraft. The solutions are based on the assumptions of incompressible and potential flow. The velocity field, pressure distribution at the deflector surface and reverser

effectiveness are predicted for deflector turning angles of 15 to 75 deg, deflector width to jet diameter ratios of 1.5 to 2.0, and ratios of deflector clearance to jet diameter of 1.0 to 3.0. Reverser effectiveness is found to be a maximum for a ratio of deflector clearance to jet diameter of about 2.0. The effect of back pressuring due to the presence of the deflector is predicted. Experimental verification of the theoretical predictions is obtained. A compressible solution obtained for a limited number of cases indicates that the incompressible solution is satisfactory for jet exit Mach numbers less than 0.8. Author

N73-11253# Aircraft Research Association, Ltd., Bedford (England).

EXPERIMENTAL DETERMINATION OF INLET CHARACTERISTICS AND INLET AND AIRFRAME INTERFERENCE

E. C. Carter Aug. 1972 24 p refs Repr. from AGARD-LS-53, Jun. 1972 23 p

(ARA-27; AGARD-LS-53-3) Avail: NTIS HC $3.25

The experimental methods of determining internal and external forces on airframe inlets are reviewed. The use of complete aerodynamic force models and partial models is discussed including the use of the full and half model tunnel techniques. Particular attention is given to drag, both basic and spillage drag, and the special techniques and accuracies required. Where necessary distinction is drawn between the use of different techniques for different inlet applications, integral parts of the inlet/airframe combination such as bleeds, diverters and dump doors are considered in the experimental methods. In order to optimize inlet and airframe integration, measuring methods for flow environment and visualization are discussed. The measurement of steady state engine face flow and distortion is discussed including the design of rakes and their interference, pressure recording methods and displays. Methods of surge simulation are described and associated unsteady measurements in the inlet. Measurement of mass flow and calibration techniques are discussed. Author

N73-11254# Technological Lab. RVO-TNO, Rijswijk (Netherlands).

THE MEASUREMENT OF SHOCK AND DETONATION WAVE PRESSURES BY MEANS OF SHOCK-INDUCED POLARIZATION OF PLEXIGLAS-DISCS

A. A. Schilperoord 30 Mar. 1972 16 p refs

(TL-1972-4; TDCK-59729) Avail: NTIS HC $3.00

The method of determining shock and detonation wave pressures is described. The experimental set-up and the experiments carried out are reviewed. The method appears to be applicable for the measurement of shock and detonation wave pressures greater than about 30 kbar with an accuracy of approximately 8 percent. As an example, the detonation pressure of TNT is calculated from the shock wave pressure in the Plexiglas disk determined by this method. Author

N73-11255# Technische Hogeschool, Delft (Netherlands). Lab. voor Aero-en Hydrodynamica.

MEMORY EFFECT IN A TURBULENT BOUNDARY-LAYER FLOW DUE TO A RELATIVELY STRONG AXIAL VARIATION OF THE MEAN-VELOCITY GRADIENT

J. O. Hinze, R. E. Sonnenberg, and P. J. H. Builtjes Sep. 1972 16 p refs

(WTHD-41) Avail: NTIS HC $3.00

Measurements were made of the distributions of mean velocity, turbulence intensities, and turbulent shear stress in a turbulent boundary layer downstream from a hemispherical cap attached onto the plane rigid wall. The eddy viscosity, when computed in the classical way according to Boussinesq's concept from the lateral gradient of the mean velocity and the turbulence shear-stress, showed a very strong nonuniform lateral distribution across the outer region of the boundary layer. Moreover, the nondimensional values of the eddy viscosity, using the wall friction velocity and the boundary layer thickness as the velocity scale and length scale respectively, were higher than those for the boundary layer when not disturbed by the wake of the spherical cap. When account is taken of an axial memory effect of the stream-wise variation of the lateral gradient of the mean velocity, the values of the nondimensional eddy viscosity are close to those for the undisturbed boundary layer. Author

N73-11256# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.

FREE JET EXPANSION FROM CONCENTRIC ORIFICES INTO VACUUM

Hakuro Oguchi, Shun-its Sato, and Osamu Inoue Jul. 1972 14 p refs Original contains color illustrations

(ISAS-486-Vol-37-12) Avail: NTIS HC $3.00

In a separate issue of two different molecular-weight gases through the concentric orifices into a vacuum, both density measurement and flow visualization are made by means of the electron beam fluorescence technique. In the experiment, the nitrogen is used as heavier gas and the helium as lighter gas. The gas dynamical interaction between outer jet of heavier (or lighter) gas and inner jet of lighter (or heavier) gas is examined, and specifically the density behavior of the gas species issued from inner orifice is clarified. Author

N73-11257# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.

APPROXIMATE SOLUTIONS OF LAMINAR FLOW BETWEEN TWO ROTATING COAXIAL DISKS

Yoshimichi Tanida Jul. 1972 11 p refs

(ISAS-485-Vol-37-11) Avail: NTIS HC $3.00

On the basis of boundary-layer approximations, an analysis is made for the laminar flow between two rotating coaxial disks in the following cases: (1) both disks are rotating with different velocities, (2) one disk is held fixed, and the other disk is rotating at a constant velocity, together with uniform discharge of fluid, and (3) a source at the centre produces small radial net flow in Case 1. Some numerical results are obtained for the case in which one disk is at rest. Author

N73-11258# Research Inst. of National Defence, Stockholm (Sweden).

VORTEX COMPONENTS AND SYSTEMS

John Sundelin Sep. 1971 49 p refs In SWEDISH; ENGLISH summary

(FOA-2-C-2480-E4) Avail: NTIS HC $4.50

A study is presented of available literature including foreign experience, and experiments which were carried out on vortex components and systems. The reverse valve, flow control valve, the so-called confined jet amplifier, and vortex tube, and applications were investigated, including the by-pass valve, pressure regulators, and flow regulators. An American method of dimensioning vortex valves is reproduced. Author

N73-11259# Technische Universitaet, Brunswick (West Germany).

EXPERIMETAL RESEARCH OF INLET FLOW IN A TUBE WITH RECTANGULAR CROSS SECTION Ph.D. Thesis [EXPERIMENTELLE UNTERSUCHUNGEN DER EINLAUFSTROEMUNG IN EINEM ROHR MIT RECHTECKQUERSCHNITT]

Horst Malitz 28 Apr. 1971 197 p refs In GERMAN

Avail: NTIS HC $12.00

Boundary layers on the walls of rectangular water pipe inlets are studied. Turbulent boundary layers of differing laminar lengths are observed along both side walls; corner boundary layers show differing expansions with variable laminar lengths and exhibit shorter laminer lengths than boundary layers in the side wall middle. It is found that positive interference is possible in the laminar to turbulent transfer regions of corner boundary layers. Transl. by G.G.

N73-11260*# Computer Sciences Corp., Falls Church, Va.

NASA CONTRIBUTIONS TO FLUIDIC SYSTEMS: A SURVEY Technology Utilization

Terry M. Weathers 1972 110 p refs

(Contract NASw-2173)

(NASA-SP-5112; LC-72-600091) Avail: NTIS; SOD $1.00 CSCL 20D

A state-of-the art review of fluidic technology is presented. It is oriented towards systems applications rather than theory or design. It draws heavily upon work performed or sponsored by NASA in support of the space program and aeronautical research and development (R&D). Applications are emphasized in this survey because it is hoped that the examples described and the criteria presented for evaluating the suitability of fluidics to new

applications will be of value to potential users of fluidic systems. This survey of the fluidics industry suggests some of the means whereby a company may use a fluidic system effectively either to manufacture a product or as part of the end product.
Author

N73-11261*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EXPERIMENTAL STUDY OF NOZZLE WALL BOUNDARY LAYERS AT MACH NUMBERS 20 TO 47
Joseph H. Kemp, Jr. and F. Kevin Owen Washington Oct. 1972 107 p refs
(NASA-TN-D-6965; A-4359) Avail: NTIS HC $3.00 CSCL 20D

The nozzle wall boundary layer of an M-50 helium tunnel was investigated with pitot pressure, total temperature, skin friction, and wall heat transfer measurements at five stations and hot wire measurements at two stations. The results indicated that the boundary layer was turbulent with a thick viscous sublayer. Pressure gradients were observed across the boundary layer; the effect of these gradients on the equations of motion are discussed. The direct skin friction measurements were higher than expected from empirical predictions; the Reynolds analogy factors however were lower than expected. Hot wire measurements indicated mass flow fluctuations as large as 80 percent of the local mean mass flow at the edge of the viscous sublayer with a maximum value relative to the edge mass flow of about 15 percent at gamma about equal to 0.8. Author

N73-11262# Advisory Group for Aerospace Research and Development, Paris (France).
TECHNICAL EVALUATION REPORT ON THE AGARD SPECIALISTS' MEETING ON TURBULENT SHEAR FLOWS
R. Michel Jul. 1972 22 p refs Conf. held at London, 13-15 Sep. 1971
(AGARD-AR-46) Avail: NTIS HC $3.25

The main techniques applied to present turbulent flow studies, theoretical and experimental, are defined. Attemps were also made to open avenues which may aid in such studies. Data cover general problems, phenomena, and analytical techniques relating to the flows. Turbulent boundary layers, wakes, and jets are discussed. E.H.W.

N73-11263*# Texas A&M Univ., College Station. Space Technology Div.
ANALYTICAL STUDY OF STRIATED NOZZLE FLOW WITH SMALL RADIUS OF CURVATURE RATIO THROATS
David J. Norton and Robert E. White Sep. 1972 213 p refs (Contract NAS9-11658)
(NASA-CR-128619; TEES-1092-TR-72-01) Avail: NTIS HC $12.75 CSCL 20D

An analytical method was developed which is capable of estimating the chamber and throat conditions in a nozzle with a low radius of curvature throat. The method was programmed using standard FORTRAN 4 language and includes chemical equilibrium calculation subprograms (modified NASA Lewis program CEC71) as an integral part. The method determines detailed and gross rocket characteristics in the presence of striated flows and gives detailed results for the motor chamber and throat plane with as many as 20 discrete zones. The method employs a simultaneous solution of the mass, momentum, and energy equations and allows propellant types, O/F ratios, propellant distribution, nozzle geometry, and injection schemes to be varied so to predict spatial velocity, density, pressure, and other thermodynamic variable distributions in the chamber as well as the throat. Results for small radius of curvature have shown good comparison to experimental results. Both gaseous and liquid injection may be considered with frozen or equilibrium flow calculations. Author

N73-11264*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMPARISON OF TURBINE ANNULUS MASS FLOW COMPUTED BY ONE- AND TWO-DIMENSIONAL ANALYSIS
Charles A. Wasserbauer and Arthur J. Glassman Washington Nov. 1972 20 p refs
(NASA-TM-X-2661; E-6909) Avail: NTIS HC $3.00 CSCL 20D

Variations in specific heat ratio, flow angle, critical velocity ratio, swirl distribution exponent, and radius ratio were considered in computing the mass flow. Variations in specific heat ratio had no significant effect and variations in critical velocity ratio had only small effect on computed mass flow between a one- and two-dimensional analysis. All non-free-vortex cases considered showed larger differences in computed mass flow between one- and two-dimensional analysis than for free vortex flow. For the non-free-vortex cases, decreasing radius ratio and increasing flow angle resulted in larger differences in mass flow as computed by the two methods. Author

N73-11265# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
COMPUTER PROGRAM FOR CALCULATING THE RESPONSE OF A PIPING NETWORK TO A SINUSOIDAL EXCITATION
W. G. Hill, Jr. Nov. 1972 34 p refs
(RM-555) Avail: NTIS HC $3.75

An impedance method was programmed in FORTRAN to compute the response of a piping network to a sinusoidal excitation. The equations used are presented, and their adequacy is discussed. Program listings are given, along with detailed descriptions and discussions of numerical problems encountered and solved during their implementation. Results of calculations performed with the programs are compared with the calculations and experiments of others. The experimental response of simple hydraulic networks is predicted accurately, and the effects of viscous damping and simple forms of pipe motion are found to be adequately represented. Author

N73-11266*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN IMPLICIT FINITE-DIFFERENCE SOLUTION TO THE VISCOUS SHOCK LAYER, INCLUDING THE EFFECTS OF RADIATION AND STRONG BLOWING
L. Bernard Garrett, G. Louis Smith, and John N. Perkins (N. C. State Univ., Raleigh) Washington Nov. 1972 123 p refs
(NASA-TR-R-388; L-8302) Avail: NTIS HC $3.00 CSCL 20D

An implicit finite-difference scheme is developed for the fully coupled solution of the viscous, radiating stagnation-streamline equations, including strong blowing. Solutions are presented for both air injection and injection of carbon-phenolic ablation products into air at conditions near the peak radiative heating point in an earth entry trajectory from interplanetary return missions. A detailed radiative-transport code that accounts for the important radiative exchange processes for gaseous mixtures in local thermodynamic and chemical equilibrium is utilized in the study. With minimum number of assumptions for the initially unknown parameters and profile distributions, convergent solutions to the full stagnation-line equations are rapidly obtained by a method of successive approximations. Damping of selected profiles is required to aid convergence of the solutions for massive blowing. It is shown that certain finite-difference approximations to the governing differential equations stabilize and improve the solutions. Detailed comparisons are made with the numerical results of previous investigations. Results of the present study indicate lower radiative heat fluxes at the wall for carbonphenolic ablation than previously predicted.

N73-11267*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AUGMENTATION OF HEAT TRANSFER BY SUBSONIC DIFFUSION AT A NEARLY SEPARATED STATE
Donald R. Boldman Washington Nov. 1972 11 p refs
(NASA-TM-X-2677; E-7082) Avail: NTIS HC $3.00 CSCL 20D

Measurements of mean velocity, turbulence intensity, and wall heat transfer were obtained in a 13 deg total angle of divergence conical diffuser coupled to a constant diameter recovery section. The results indicated that the boundary layer was in a nearly separated state. Turbulence intensity levels approaching 0.4 were observed in the latter stages of diffusion. The convective heat transfer was always equal to or higher than corresponding values for fully developed pipe flow at the same Reynolds number. The augmentation in heat transfer was greatest during the latter stages of diffusion where the Stanton number was nearly three times the pipe flow value. Author

N73-11268*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SURFACE-FLOW, PRESSURE, AND HEAT-TRANSFER STUDIES ON TWO CONICAL DELTA WINGS AT A MACH NUMBER OF 6
Jerry N. Hefner and Allen H. Whitehead, Jr. Washington Dec. 1972 19 p refs
(NASA-TM-X-2668; L-8548) Avail: NTIS HC $3.00 CSCL 20D

An experimental investigation of the surface flow, pressures, and heat transfer on two conical delta wings having attached leading-edge shocks has been conducted at a Mach number of 6. The angle of attack was varied between 0 deg and 12 deg. The pressure data were compared with predictions obtained by the method-of-lines technique, and the heating data were compared with the heating levels predicted by the Spalding-Chi method. Author

N73-11269# ARO, Inc., Arnold Air Force Station, Tenn.
EFFECT OF SKIMMER INTERACTION ON THE PROPERTIES OF PARTIALLY CONDENSED MOLECULAR BEAMS Final Report, 19 Aug. 1971 - 24 Feb. 1972
A. B. Bailey, M. R. Busby, and R. Dawbarn AEDC Aug. 1972 40 p refs
(AF Proj. 7635; ARO Proj. VW5224)
(AD-746292; ARO-VKF-TR-72-59; AEDC-TR-72-100) Avail: NTIS CSCL 20/4

A considerable theoretical and experimental effort has been devoted to the problem of producing high-intensity molecular beams. These beams have been formed by skimming from the supersonic core of a free-jet expansion. Many experimental studies have been devoted to determining the effect of the skimmer upon the molecular beam properties. Through the extensive use of cryopumping in the source, collimation, and test chambers of a molecular beam test facility, it has been possible to identify some of the factors affecting beam intensity in noncondensed and condensed flows. The location of a warm annular surface with inner and outer diameters of 14.5 and 23 cm, respectively, at the cryopumped end wall resulted in a significant attenuation of the incident beam intensity. With the onset of condensation, it has been shown that nonpumping skimmers and end walls reduce the incident beam intensity. Measurements of gas velocity in a condensed flow indicate that a nonpumping surface placed in the beam affects not only beam intensity but also the beam velocity. GRA

N73-11270# Naval Ordnance Lab., White Oak, Md.
CALCULATION OF MAGNUS FORCES ON AXISYMMETRIC BODIES AT SMALL ANGLES OF ATTACK WITH INCOMPRESSIBLE TURBULENT BOUNDARY LAYERS
Neal Tetervin 21 Mar. 1972 158 p refs
(AD-746449; NOLTR-72-80) Avail: NTIS CSCL 20/4

The Magnus force is found by adding the boundary layer displacement surface to the body and then calculating the force on the resulting non-axisymmetric body. The displacement surface is calculated by the simultaneous integation of a differential equation for a streamline, two partial-differential boundary layer integral-momentum equation with the boundary layer thickness and the tangent of the angle between the local direction of the surface friction and potential flow streamline as dependent variables, and a partial differential equation for the displacement surface thickness. The method is applied to a half-ellipsoid of fineness ratio 5 at 4 degrees angle of attack. Slender-body theory is used to calculate the force. Author (GRA)

N73-11271# Purdue Univ., Lafayette, Ind.
ANALYSIS OF UNSTEADY AERODYNAMIC EFFECTS ON AN AXIAL-FLOW COMPRESSOR STAGE WITH DISTORTED INFLOW
Franklin O. Carta (United Aircraft Res. Labs., East Hartford, Conn.) Jul. 1972 122 p refs
(Contract N00014-67-A-0226-005; NR Proj. 098-038; Proj. SQUID)
(AD-746457; SQUID-TR-UARL-1-PU) Avail: NTIS CSCL 20D

An analytical procedure has been developed to predict the circumferential pressure profile at the exit of a compressor stage subjected to a spatially steady inlet distortion. Expressions have been developed relating the pressure ratio and weight flow characteristics of an axial-flow compressor stage to the normal force and drag characteristics of an isolated airfoil. These steady-state interrelations between rotor and isolated airfoil were used to apply available unsteady data for isolated airfoils in the study of distorted inflow effects. Both unsteady and quasi-steady predictions were made and were compared with available experimental results from low-speed compressor tests. Author (GRA)

N73-11272# Larock (Bruce E.), Davis, Calif.
TRANSVERSE GRAVITY EFFECTS ON A FULLY CAVITATING HYDROFOIL RUNNING BELOW A FREE SURFACE Final Technical Report, Dec. 1971 - Jul. 1972
Bruce E. Larock Jul. 1972 73 p refs
(Contract N00014-72-C-0109; SR0090101)
(AD-746484; TR-7201) Avail: NTIS CSCL 13/10

Equations are presented which describe the fully cavitating flow of fluid past a flat plate hydrofoil running below a free surface. Transverse gravity field effects are included in the analysis. The equations are developed by the use of complex function theory and Tulin's double-spiral-vortex cavity model. Two FORTRAN 4 computer programs have been developed to evaluate the equations. Features and use of these programs are discussed, and program listings are presented in the appendix. Author (GRA)

N73-11273# Naval Postgraduate School, Monterey, Calif.
SUBSONIC LIFTING SURFACE ANALYSIS WITH STATIC AEROELASTIC EFFECTS M.S. Thesis
Larry Glen Pearson Jun. 1972 74 p refs
(AD-745894) Avail: NTIS CSCL 20/4

A computer program was coded to obtain static aeroelastic effects on simple planforms through the use of subsonic lifting surface theory. The program was divided into two major technical areas, aerodynamic and structural, with matrix notation used to indicate the influence of each in the final aerodynamic loading distribution. Several typical stability derivatives were then obtained to make an accurate stability and control analysis on the desired planform. Author (GRA)

N73-11274# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
ELECTRON BEAM DENSITOMETER INVESTIGATION OF DIFFUSIVE SEPARATION IN FRONT OF A BLUNT BODY IN LOW DENSITY HELIUM-ARGON FLOWS
G. E. McMichael Aug. 1971 155 p refs
(Grant AF-AFOSR-2091-71; AF-AFOSR-1481-68A; AF Proj. 9783)
(AD-745960; UTIAS-167; AFOSR-72-1196TR) Avail: NTIS CSCL 20/4

Diffusive separation in front of a blunt body in low density binary mixture supersonic flows is of experimental interest for several reasons. Both in low density flows in laboratories, and in rocket born instrumentation studies of planetary atmospheres, sampling probes in conjunction with mass spectrometers can be used to determine flow composition. At present, this flow field has not been described theoretically, and the magnitude and mechanism of probe induced separation effects is not well understood. To aid in understanding such flow fields, partial density measurements were made in the bow shock and stagnation region of a flat ended cylinder in a rarefied helium-argon supersonic free jet flow. Author (GRA)

N73-11275# Army Missile Command, Redstone Arsenal, Ala. Propulsion Directorate.
A NOMOGRAPHIC PROCEDURE TO CALCULATE GAS FLOW PARAMETERS
M. Rhoden 10 Apr. 1972 43 p
(DA Proj. 1T0-61101-A-91)
(AD-745898; RK-TR-72-6) Avail: NTIS CSCL 20/4

The purpose of the report is to present graphical solutions to the equations for isentropic flow of ideal gases at subsonic, sonic, and supersonic velocities. Knowing only the weight flow, molecular weight, pressure, temperature, k values, and the exit pressures (vacuum), the reader will be able to design a flow system by specifying pipe sizes, venturi throats, and exit diameters without the use of computers. Author (GRA)

N73-11276# Army Weapons Command, Rock Island, Ill. Weapons Lab.
DEVELOPMENT OF A FINITE ELEMENT APPROACH FOR APPROXIMATE ANALYSIS OF UNSTEADY COMPRESSIBLE FLUID FLOW
Paul E. Ehle and Albert E. Rahe Jun. 1972 63 p refs
(DA Proj. 1T0-61101-A-91-A)
(AD-746234; SWERR-TR-72-36) Avail: NTIS CSCL 20/4

A finite element method is developed to approximately analyze unsteady compressible gas flow in one spatial dimension. Extension of this analysis to three dimensions is possible. The present method, as programmed for an IBM 360/65 computer, is suited for a variety of one-dimensional flow situations, except those characterized by extremely large rates of pressure change. The form of the equations is such that heat and mass sources, and sinks, frictional losses, cross-sectional area changes, and other quantities of engineering significance can readily be incorporated. The analysis can serve as a mathematical model to approximate some of the dynamic phenomena in gas flow.
Author (GRA)

N73-11277# Naval Research Lab., Washington, D.C.
A REVIEW AND EVALUATION OF DRAG REDUCTION THEORIES Interim Report
Ronald Darby Jun. 1972 57 p refs
(AD-746107; NRL-MR-2446) Avail: NTIS CSCL 20/4

A survey of the drag reduction literature has been conducted, with a view toward comparing and evaluating various proposed theories or mechanisms which have been postulated in order to explain or describe turbulent drag reduction by polymeric additives. Both molecular and continuum theories have been considered, although none has yet proved adequate for quantitative prediction of drag reduction. Viscoelastic properties sufficient to produce drag reduction are demonstrated. The mutual interaction between viscoelastic rheological properties and the structure of turbulent flows needs to be established before drag reduction can be completely understood or described. Author (GRA)

N73-11278# Aeronautical Research Associates of Princeton, Inc., N.J.
LINEARIZED INTEGRAL THEORY OF THE VISCOUS COMPRESSIBLE FLOW PAST A WAVY WALL
John E. Yates Jul. 1972 70 p refs
(Contract F44620-71-C-0132; AF Proj. 9782)
(AD-746332; ARAP-177; AFOSR-72-1335TR) Avail: NTIS CSCL 20/4

Two integral theories for compressible flow are derived from the calculation of pressure on a perturbed plane wall in the presence of viscous boundary layer. A simple theory is derived from the von Karman momentum integral equation, and a rational theory is derived by iteration from asymptotic perturbation theory. In both theories, the wall pressure amplitude and phase angle are functions of a single similarity parameter X which is proportional to boundary layer thickness. The two theories are compared with experimental results and with numerical calculations based on asymptotic perturbation theory. Qualitative and quantitative results based on the rational integral theory are compared with experimental results. Author (GRA)

N73-11279# Naval Postgraduate School, Monterey, Calif.
THE PERFORMANCE CHARACTERISTICS OF GEOMETRICALLY SIMILAR BISTABLE AMPLIFIERS Final Report
Turgut Sarpkaya 17 Jul. 1972 40 p refs
(AD-745770; NPS-59SL72071A) Avail: NTIS CSCL 13/7

The results of a comprehensive study of the comparative performance characteristics of geometrically similar vented and unvented bistable amplifiers, together with their actual dimensions, are presented. The Reynolds number in the tests ranged from 9,750 to 60,000, Mach number from 0.07 to 0.42, and the power jet velocity from 75 to 460 ft/sec. Each amplifier as conceived and designed was capable of giving a maximum of geometric flexibility which enabled a systematic evaluation of the shape and location of the splitter plate and Coanda walls.
Author (GRA)

N73-11280# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF HYDRAULICS
A. V. Teplov, L. N. Vikhanskii, and V. E. Charei 14 Apr. 1972 345 p refs Transl. into ENGLISH from the monograph "Osnovy Gidravliki" Leningrad, 1969 p 1-223
(AF Proj. 7343)
(AD-746713; FTD-HT-23-1604-71) Avail: NTIS CSCL 13/7

The report contains information on hydrostatics, the basic concepts and laws of hydrodynamics, classification and methods for considering losses in head with motion of fluids, and processes of the discharge of a fluid through openings and fittings. The basic concepts, processes, and equations of thermodynamics are presented. The book includes general information from the theory of pumps, and also reciprocating and rotary compressors. Special sections are devoted to reciprocating, centrifugal, gear-type, and rotary pumps. The elements of hydraulic systems and pneumatic devices for metal-cutting machines are examined. The text book is designed for students in machine-building technical schools.
Author (GRA)

N73-11281# Ballistic Research Labs., Aberdeen Proving Ground, Md.
ON WAVE PROPAGATION IN A MIXTURE OF LINEAR ELASTIC MATERIALS
Ray M. Bowen and Thomas W. Wright May 1972 66 p refs
(DA Proj. 1T0-61102-A-33E)
(AD-746617; BRL-1581) Avail: NTIS CSCL 07/4

The work concerns the propagation of wave fronts in a mixture of fluids and isotropic solids. Only mechanical effects are included. In the derivation of the equations the importance of buoyancy forces is demonstrated. It is shown that these forces arise from a local interaction among the constituents of the mixture and are present even in the absence of diffusion. It is also shown that there are as many longitudinal waves possible as there are constituents and that there are as many transverse waves possible as there are solid constituents. Rules for the evolution of discontinuities on wave fronts are deduced. Diffusion causes a decay in wave strength which is additional to the usual geometric decay familiar from classical elasticity.
Author (GRA)

N73-11282# Hebrew Univ., Jerusalem (Israel). Microwave Div.
OPTICAL MEASUREMENTS AND MICROWAVE MEASUREMENTS BEHIND SHOCK WAVES Progress Report, 1 Jul. - 30 Nov. 1971
W. Low Dec. 1971 23 p refs
(Contract EOOAR-70-0080; AF Proj. 9783)
(AD-745969; AFOSR-72-1296TR; PR-4) Avail: NTIS CSCL 07/4

Microwave attenuation and neutral gas density profiles were measured behind shock waves in air, at initial pressure of 5 torr in the shock Mach No. range of 8 - 10. From these data, formation times of atomic oxygen and ionization relaxation times were obtained. It is shown that the formation time of atomic oxygen agrees well with different theoretical calculations. The ionization relaxation time fits the theoretical curve obtained by Lin and Fyfe. The electron peak density was found to be 2 - 3 times higher than the values calculated for thermodynamic equilibrium. The neutral gas density was measured with the aid of a simple laser interferometer. Author (GRA)

N73-11283# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.
ASYMPTOTIC ANALYSIS OF TURBULENT CHANNEL FLOW FOR MIXING LENGTH THEORY
William B. Bush (Univ. of Southern Calif., Los Angeles) and Francis E. Fendell (TRW Systems, Redondo Beach, Calif.) Jun. 1972 40 p refs
(Contract N00014-67-A-0226-0005; NR Proj. 098-038; Proj. SQUID)
(AD-746112; SQUID-TR-TRW-3-PU) Avail: NTIS CSCL 20/4

Limit process expansion techniques are used to analyze fully developed turbulent incompressible flow in an infinitely long channel with plane parallel walls. Closure of the Reynolds time-averaged equations of motion is effected through the introduction of an eddy viscosity linearly proportional to the mean rate of strain, such that the Reynolds stress is quadratic in the mean rate of strain: the closure is a generalization of mixing-length theory. Expansions are carried out in the limit of the turbulent Reynolds number going to infinity, where the turbulent Rey-

nolds number is the ratio of the eddy viscosity to the molecular viscosity. Author (GRA)

N73-11284# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineering.
ON THREE-DIMENSIONAL STRUCTURE OF TRANSONIC FLOWS
H. K. Cheng and Mohammed M. Hafez Jul. 1972 47 p refs
(Contract N00014-67-A-0269-0021; NR Proj. 061-192)
(AD-747266; USCAE-121) Avail: NTIS CSCL 20/4

The basic structure of three-dimensional transonic flows past lifting configurations having finite leading-edge swept angles are studied. Unlike the axisymmetric structure following the transonic area rule, the inviscid transonic small-disturbance regime admits three principal domains, representing different degree of asymmetry controlled by the lift and side forces. An outline of the basic theory and a transonic equivalence rule that follows are presented; the implication of this research to other transonic studies related to far-field properties and to flow field computations are discussed. The possibility of an extension and application to yawed critical wings is pointed out. Author (GRA)

N73-11285# Colorado State Univ., Fort Collins.
MEAN TURBULENT FLOW IN THE ENTRY REGION OF A ROUGH PIPE
J. Paul Tullis and Jeng-Song Wang Jul. 1972 127 p refs
(Contract N00014-67-A-0299-0013)
(AD-747278; CER72-73JPT-JSW-2) Avail: NTIS CSCL 20/4

General characteristics of mean turbulent flow in the entry region of a pipe were investigated. The development of wall shear stress, velocity profile, core velocity, and boundary layer thickness was studied. A mathematical model for predicting boundary layer growth in developing flow is presented. Momentum and continuity equations were used with assumptions of (1) potential flow in the core region, (2) a semi-log velocity profile for the boundary layer, and (3) a measured resistance formula from the experimental data. Results show that the model can predict satisfactorily within the first 10 to 12 pipe diameters. The experimental data were obtained in a 12-inch diameter hydraulically rough pipe. Turbulence was suppressed and a developing boundary layer was formed by a settling chamber with a converging nozzle. Water was used as the fluid. GRA

N73-11286# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TEMPERATURE DEPENDENCE OF THE VISCOSITY OF SIMPLE LIQUIDS
A. A. Adkhamov and Sh. Shokirov 7 Apr. 1972 11 p refs Transl. into English from Dokl. Akad. Nauk Tadzh. SSR (stalinabad), 1968 p 17-20
(AD-747089; FTD-MT-24-1378-71) Avail: NTIS CSCL 20/4

The purpose of the work is investigation of the temperature dependence of the viscosity of simple liquids on the basis of the molecular-kinetic theory. In literature there is vast experimental material on the investigation of the viscosity of liquids and its temperature dependence both based on the line of saturation and in the case of constant density. However, the molecular theory of the viscous properties of liquids is weakly developed due to the complexity of structure and the nature of the thermal movement of their molecular. Author (GRA)

N73-11287# Stanford Univ., Calif. Dept. of Applied Mechanics.
MOVING LOAD ON A FLUID SOLID INTERFACE: SUBSONIC AND INTERSONIC REGIMES
Timothy C. Kennedy and George Herrmann Aug. 1972 51 p refs
(Contract N00014-67-A-0112-0065; NR Proj. 064-525)
(AD-747253; SU-SUDAM-72-12) Avail: NTIS CSCL 20/11

The steady-state response of a semi-infinite solid, with an overlying semi-infinite fluid, subjected at the plane interface to a moving point load is determined for subsonic and intersonic load velocities. The displacements of the solid and the velocity potential of the fluid are obtained in terms of algebraic expressions and single finite integrals which can be readily evaluated numerically. Some numerical results for the displacements at the interface are presented and compared to the results obtained in the absence of the fluid. Author (GRA)

N73-11288# Bell Aerospace Co., Buffalo, N.Y.
SUBMARINE PARAMETER IDENTIFICATION Final Report, Jan. 1971 - Jun. 1972
Gerald L. Perrault, Theodore L. Roess, and Frederic D. Powell Jun. 1972 123 p refs
(Contract N00014-71-C-0162; SR0090101)
(AD-747315; Rept-9500-920237) Avail: NTIS CSCL 13/10

Research was conducted to determine the feasibility of adaptively identifying the values of the hydrodynamic parameters of a submarine or model from submerged free-flight trajectory data. The modified Kalman filter approach which was used was based on the equation-error parameter identification principle instead of the more conventional response error method, resulting in a relatively modest computational requirement. If the controls are driven by appropriate pseudo-random noise sequences, it is possible to determine almost all the parameters to good accuracy from a five minute trajectory sample which is contaminated by realistic additive noise plus bias. Several configurations of suitable instruments for measuring the trajectory are described and the algorithms for processing the trajectory data are discussed. Author (GRA)

N73-11289# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
INTERNATIONAL SYMPOSIUM ON RAREFIED GAS DYNAMICS (8TH), VOLUME 1
K. Karamcheti Jul. 1972 330 p refs Conf. held at Stanford, Calif., 10-14 Jul. 1972
(AFOSR MIPR 72-0001; AF Proj. 9783)
(AD-745974; AFOSR-72-1276TR) Avail: NTIS CSCL 20/4

The abstracts of the contributed papers of the Eighth International Symposium on RGD comprise the contents of two volumes. Volume 1 contains materials dealing with kinetic theory, shock structure, electron beam diagnostics, polyatomic and radiating gases, internal flows, expansions and jets. These books of abstracts constitute the only source of the complete record of the papers presented at the symposium. The proceedings of the symposium contain in detail only some of the papers. Author (GRA)

N73-11290# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE QUESTION OF VELOCITY PROFILES OF TURBULENT FLOW ON A POROUS SURFACE
A. G. Baskakova, V. T. Movchan, and A. M. Pepeverzev 6 Jun. 1972 10 p refs Transl. into ENGLISH from Gidromekhanika (USSR), no. 17, 1971 p 50-53
(AF Proj. 7343)
(AD-746933; FTD-HT-23-919-72) Avail: NTIS CSCL 20/4

The plane turbulent gradient flow incompressible fluid along a porous surface in the presence of blowing or suction is analyzed. An expression for the velocity profiles is derived on the basis of Prandtl's relation between friction stresses and the energy of the pulsating velocity components, using a polynomial representation of the friction stress in the boundary layer. Author (GRA)

N73-11291# Institute for Defense Analyses, Arlington, Va.
INTERNAL WAVE-SURFACE WAVE INTERACTIONS REVISITED
F. Zachariasen Mar. 1972 28 p
(Contract DAHC15-67-C-0011)
(AD-747332; P-853; IDA/HQ-72-14188) Avail: NTIS CSCL 20/4

The interaction of internal waves and surface waves in water is explored in the regions where the effects of the interaction are small. Explicit solutions for an arbitrary internal wave are given for various kinds of boundary conditions, with a detailed discussion of the conditions under which they are valid. The connection of the solutions with the conservation equations is made explicit, and the modifications produced by viscous damping are outlined. Author (GRA)

N73-11292# Virginia Polytechnic Inst. and State Univ., Blacksburg.
BOUNDARY-LAYER SEPARATION FROM MOVING BOUNDARIES
D. P. Telionis and M. J. Werle Aug. 1972 40 p refs Prepared in cooperation with Cincinnati Univ., Ohio

(Grant AF-AFOSR-2361-72)
(AD-746869; VPI-E-72-13) Avail: NTIS CSCL 01/3

The laminar boundary-layer equations for incompressible flow with a mild adverse pressure gradient were numerically solved for flows over moving boundaries. It was demonstrated that the vanishing of skin friction in this case is not related to separation. Indeed the integration proceeds smoothly through a point of vanishing skin friction and further downstream a Goldstein-type singularity appears at a station where all the properties of separation according to the model of Moore, Rott and Sears are present. It is also numerically demonstrated that the singular behavior is not uniform with n, the distance perpendicular to the wall, but it is initiated at a point away from the wall leaving below a region of nonsingular flow. Author (GRA)

N73-11293# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.

THE MATHEMATICAL FORMULATION OF VISCOUS-INVISCID INTERACTION PROBLEMS IN SUPERSONIC FLOW

Gabriel Miller Jun. 1972 30 p refs
(Contract N00014-67-A-0467-0021)
(AD-746891; NYU-AA-72-11) Avail: NTIS CSCL 20/4

The problem area of the interaction between the viscous and inviscid flowfields around a body is investigated. The study is based on ascertaining a flow model which has the ability of determining interaction effects without the possibility of having to choose between an infinite number of possible solutions. The importance of the inclusion of a two-family characteristic net for the outer supersonic flow and the normal momentum for the inner viscous flow is discussed and the necessity of their inclusion in order to have a properly posed model is presented. A result of the numerical analysis based on the flow model is presented and the uniqueness of such results is discussed.
GRA

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N73-11294 National Lending Library for Science and Technology, Boston Spa (England).

OPTICAL CHARACTERISTICS OF WATER MASSES AS INDICES OF THE PROCESSES OF TURBULENT MIXING IN THE SEA

V. I. Voitov Oct. 1972 14 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 4, no. 3, 1964 p 386-395
(NLL-RTS-7536) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.40; 5 NLL photocopy coupons

A method of using the attenuation coefficient of the sea water to compute the vertical and horizontal coefficients of turbulent mixing is described. The attenuation coefficient is registered continuously on photoelectric transparency meters, and the suspended matter is considered to be chiefly phytoplankton. The vertical coefficient of turbulent diffusion is calculated based on a simplified variant of the general equation of diffusion. The flow of phytoplankton caused by turbulent diffusion and gravitational settling is assumed to be balanced by the growth in biomass of the phytoplankton. The horizontal diffusion is inferred from the temporal variation of phytoplankton concentrations which are carried by the currents. The real values of turbulent diffusion coefficients and the variation in the vertical coefficient with depth are obtained. N.E.N.

N73-11295 National Lending Library for Science and Technology, Boston Spa (England).

ON THE OPTICAL SCATTERING LAYERS IN THE SEA

G. G. Neuimin and N. A. Sorokina Oct. 1971 5 p refs Transl. into ENGLISH from Okeanologiya (Moscow), v. 4, no. 1, 1964 p 51-54
(NLL-RTS-7535) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.50 or 2 NLL photocopy coupons

Vertical distribution of transparency is studied with submerged transparency meters. Several clearly defined layers with reduced transparency are observed. Tyndall effect measurements of reduced transparency in these layers caused by increased dispersion of light by suspended particles is reviewed. The differential equations for concentration distribution of matter in water is also presented. J.A.M.

N73-11296*# Michigan Univ., Ann Arbor. Willow Run Labs.

[ERTS COMPUTER COMPATIBLE TAPE DATA PROCESSING AND ANALYSIS. APPENDIX 1: THE UTILITY OF IMAGING RADARS FOR THE STUDY OF LAKE ICE] Bimonthly Progress Report, 1 Sep. - 31 Oct. 1972

Fabian C. Polcyn, Fred J. Thomson, L. J. Porcello, I. J. Sattinger, W. A. Malila, C. T. Wezernak, Robert Horvath, Robert K. Vincent, Principal Investigators, and M. L. Bryan 31 Oct. 1972 30 p refs
(Contract NAS5-21783)
(E72-10198; NASA-CR-129064; Rept-11229-10-L; BMPR-2) Avail: NTIS HC $3.50 CSCL 08M

There are no author-identified significant results in this report. Remotely sensed multispectral scanner and return beam vidicon imagery from ERTS-1 is being used for: (1) water depth measurements in the Virgin Islands and Upper Lake Michigan areas; (2) mapping of the Yellowstone National Park; (3) assessment of atmospheric effects in Colorado; (4) lake ice surveillance in Canada and Great Lakes areas; (5) recreational land use in Southeast Michigan; (6) International Field Year on the Great Lakes investigations of Lake Ontario; (7) image enhancement of multispectral scanner data using existing techniques; (8) water quality monitoring of the New York Bight, Tampa Bay, Lake Michigan, Santa Barbara Channel, and Lake Erie; (9) oil pollution detection in the Chesapeake Bay, Gulf of Mexico southwest of New Orleans, and Santa Barbara Channel; and (10) mapping iron compounds in the Wind River Mountains. A.L.

N73-11297*# Environmental Research and Technology, Inc., Lexington, Mass.

EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SEA ICE Bimonthly Progress Report, 31 Aug. - 31 Oct. 1972

James C. Barnes, Principal Investigator 10 Nov. 1972 12 p
(Contract NAS5-21802)
(E72-10199; NASA-CR-129065; ERT-P-408-2) Avail: NTIS HC $3.00 CSCL 08L

The are no author-identified significant results in this report.

N73-11298*# Science Applications, Inc., La Jolla, Calif.

DETERMINATION OF AEROSOL CONTENT IN THE ATMOSPHERE FROM ERTS-1 DATA Progress Report, 7 Sep. - 6 Nov. 1972

Claus B. Ludwig, Principal Investigator and M. Griggs 7 Nov. 1972 11 p
(Contract NAS5-21860)
(E72-10200; NASA-CR-129066; SAI-72-589-LJ; PR-1) Avail: NTIS HC $3.00 CSCL 04A

There are no author-identified significant results in this report.

N73-11299*# Environmental Research and Technology, Inc., Lexington, Mass.

EVALUATE THE APPLICATION OF ERTS-A DATA FOR DETECTING AND MAPPING SNOW COVER Bimonthly Progress Report, 31 Aug. - 31 Oct. 1972

James C. Barnes, Principal Investigator 10 Nov. 1972 8 p
(Contract NAS5-21803)
(E72-10202; NASA-CR-129068; ERT-P-407-2; BMPR-2) Avail: NTIS HC $3.00 CSCL 08L

The author has identified the following significant results. Preliminary results of the analysis of a limited sample of ERTS-1 data from the western United States and the Arctic indicate that snow cover can be detected in the MSS-4 and MSS-5 bands by its high reflectance compared to that of the surrounding snow-free terrain. Snow can generally be distinguished from clouds because of well-defined boundaries as compared with the less distinct cloud edges, the lack of shadows characteristic of clouds, and pattern configurations that fit closely with higher elevations and terrain features. At higher latitudes where repetitive ERTS-1 coverage occurs snow can also be

identified by the day-to-day continuity of the patterns. In the longer wavelengths, particularly the MSS-7 band, the contrast between snow and snow-free terrain is much lower, and, thus, snow is more difficult to detect. ERTS-1 data from the Canadian Arctic shows the seasonal increase in snow cover in several areas. In other ERTS-1 data, considerable detail is evident in glaciers located along the east and west coasts of Greenland. A.L.

N73-11300*# Idaho Univ., Moscow. Coll. of Forestry, Wildlife and Range Sciences.

APPLICATION OF REMOTE SENSING IN THE STUDY OF VEGETATION AND SOILS IN IDAHO

E. W. Tisdale, Principal Investigator 13 Nov. 1972 1 p Sponsored by NASA

(E72-10203; NASA-CR-129069) Avail: NTIS HC $3.00 CSCL 08F

There are no author-identified significant results in this report.

N73-11301*# Purdue Univ., Lafayette, Ind. Lab. for Application of Remote Sensing.

AN INTERDISCIPLINARY ANALYSIS OF ERTS DATA FOR COLORADO MOUNTAIN ENVIRONMENTS USING ADP TECHNIQUES. AN EARLY ANALYSIS OF ERTS-1 DATA Bimonthly Progress Report, 1 Sep. - 31 Oct. 1972

Roger M. Hoffer, D. A. Landgrebe, Principal Investigators, and F. E. Goodrick 31 Oct. 1972 29 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (Contract NAS5-21880)

(E72-10204; NASA-CR-128446; LARS-092972) Avail: NTIS HC $3.50 CSCL 08G

There are no author-identified significant results in this report. The principal problem encountered has been the lack of good quality, small scale baseline photography for the test areas. Analysis of the ERTS-1 data for the San Juan Site will emphasize development of a preliminary spectral classification defining grass cover categories, and then selection of subframes for intensive investigation of the forestry, geologic, and hydrologic properties of the area. Primary work has been devoted to the selection and digitization of areas for topographic modeling, and compilation of ground based data maps necessary for computer analysis. Study effort has emphasized: geomorphic features; macro-vegetation; micro-vegetation; snow-hydrology; insect/disease damage; and blow-down. Analysis of a frame of the Lake Texoma area indicates a great deal of potential in the analysis and interpretation of ERTS imagery. Preliminary results of investigations of geologic, forest, range, cropland, and water resources of the area are summarized. A.L.

N73-11302*# Earth Satellite Corp., Washington, D.C.

FACILITATING THE EXPLOITATION OF ERTS IMAGERY USING SNOW ENHANCEMENT TECHNIQUES Seminnual Progress Report, 26 May - 31 Oct. 1972

Frank J. Wobber, Principal Investigator, Kenneth Martin, Charles Sheffield, Orville Russell, and Roger Amato 16 Nov. 1972 39 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198

(E72-10205; NASA-CR-128470) Avail: NTIS HC $4.00 CSCL 08L

The author has identified the following significant results. Analysis of all available (Gemini, Apollo, Nimbus, NASA aircraft) small scale snow covered imagery has been conducted to develop and refine snow enhancement techniques. A detailed photographic interpretation of ERTS-simulation imagery covering the Feather River/Lake Tahoe area was completed and the 580-680nm. band was determined to be the optimum band for fracture detection. ERTS-1 MSS bands 5 and 7 are best suited for detailed fracture mapping. The two bands should provide more complete fracture detail when utilized in combination. Analysis of early ERTS-1 data along with U-2 ERTS simulation imagery indicates that snow enhancement is a viable technique for geological fracture mapping. A wealth of fracture detail on snow-free terrain was noted during preliminary analysis of ERTS-1 images 1077-15005-6 and 7, 1077-15011-5 and 7, and 1079-15124-5 and 7. A direct comparison of data yield on snow-free versus snow-covered terrain will be conducted within these areas following receipt of snow-covered ERTS-1 imagery.

N73-11303*# TRW Systems Group, Redondo Beach, Calif.

EVALUATION OF DIGITAL CORRECTION OF TECHNIQUES FOR ERTS IMAGES Bimonthly Progress Report, Sep. - Oct. 1972

John E. Taber, Principal Investigator Oct. 1972 3 p (Contract NAS5-21814)

(E72-10206; NASA-CR-128473) Avail: NTIS HC $3.00 CSCL 09B

There are no author-identified significant results in this report.

N73-11304*# Army Cold Regions Research and Engineering Lab., Hanover, N.H.

ARTIC AND SUBARCTIC ENVIRONMENTAL ANALYSES UTILIZING ERTS-1 IMAGERY. COLD REGIONS ENVIRONMENTAL ANALYSIS BASED ON ERTS-1 IMAGERY (PREPRINT) Bimonthly Progress Report, 23 Aug. - 23 Oct. 1972

Duwayne M. Anderson, Principal Investigator, R. K. Haugen, L. W. Gatto, C. W. Slaughter, T. Marlar, and H. L. McKim 23 Oct. 1972 19 p refs Preprint presented at 8th Intern. Symp. on Remote Sensing of Environ., Ann Arbor, Mich., 2-6 Oct. 1972 Original contains imagery. Original photography may be purchased from EROS Data Center, 10th and Dakota Avenue, Sioux Falls, S. D. 57198 (NASA Order S-70253-AG)

(E72-10209; NASA-CR-128480; BMPR-2) Avail: NTIS HC $3.00 CSCL 08L

There are no author-identified significant results in this report. An overriding problem in arctic and subarctic environmental research has been the absence of long-term observational data and the sparseness of geographical coverage of existing data. A first look report is presented on the use of ERTS-1 imagery as a major tool in two large area environmental studies: (1) investigation of sedimentation and other nearshore marine processes in Cook Inlet, Alaska; and (2) a regional study of permafrost regimes in the discontinuous permafrost zone of Alaska. These studies incorporate ground truth acquisition techniques that are probably similar to most ERTS investigations. Studies of oceanographic processes in Cook Inlet will be focused on seasonal changes in nearshore bathymetry, tidal and major current circulation patterns, and coastal sedimentation processes, applicable to navigation, construction, and maintenance of harbors. Analyses will be made of the regional permafrost distribution and regimes in the Upper Koyukuk-Kobuk River area located in NW Alaska. A.L.

N73-11305*# Kennecott Exploration, Inc., Salt Lake City, Utah. Exploration Services Dept.

RECOGNITION OF THE GEOLOGIC FRAMEWORK FOR COPPER PORPHYRY-TYPE DEPOSITS ON ERTS-1 IMAGERY Progress Report, 30 Jun. - 30 Oct. 1972

John C. Wilson, Principal Investigator 22 Nov. 1972 2 p (Contract NAS5-21769)

(E72-10210; NASA-CR-128481) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N73-11306*# Ecole Pratique des Hautes Etudes, Paris (France).

THE FRALIT TELEDETECTION PROGRAM, USING THE ERTS-A SATELLITE, FOR THE OCEANIC LITTORAL OF FRANCE [LE PROGRAM FRALIT TELEDETECTION, PAR LE SATELLITE ERTS-A, DU LITTORAL OCEANIQUE DE LA FRANCE]

F. Verger, Principal Investigator, Ch. Cazabat, P. Demathieu, and J. Dupuis [1972] 10 p refs In FRENCH Sponsored by NASA

(E72-10211; NASA-CR-128482) Avail: NTIS HC $3.00 CSCL 08J

There are no author-identified significant results in this report. The French Atlantic Littoral program, utilizing data from the ERTS-1 satellite, is considered. It involves teledetection of the French shoreline along the Atlantic Ocean and English Channel. A description is given of the ERTS-1 orbit and the satellite itself, including the attitude control system, and the data acquisition and transmission equipment. The geographic extent

of the area covered by the program is delineated and the subjects studied are enumerated. These include the geomorphology, pedology, hydrology, and vegetation of the maritime marshes; sedimentology, morphology, and hydrology of the intertidal zones; and transport of material in suspension to the mouths of the Seine, the Loire, and the Gironde as a part of the coastal waters study. Transl. by K.P.D.

N73-11307*# Arizona Univ., Tucson. Optical Sciences Center.
DETERMINATION OF THE INFLIGHT OTF OF ORBITAL EARTH RESOURCES SENSORS
P. N. Slater, Principal Investigator and R. A. Schowengerdt Oct. 1972 23 p refs Presented at 9th Congr. of the Intern. Comm. for Optics, Santa Monica, Calif.
(Contract NAS5-21849; NAS9-9333)
(E72-10212; NASA-CR-128483) Avail: NTIS HC $3.25 CSCL 14E

There are no author-identified significant results in this report. A technique has been investigated that is particularly applicable to evaluation of earth-orbiting multispectral sensors. In all programs employing such sensors, simultaneous underflight photography from aircraft is made during passes of the spacecraft. To evaluate the spacecraft imagery, the two sets of photographs are scanned and digitized with a microdensitometer. The data are then Fourier analyzed, and the spatial frequency spectra is calculated. The spatial frequencies in the underflight trace are scaled to those in the spacecraft trace, and the ratio of the spectra gives the in-flight optical transfer function (OTF) for the orbiting sensor. The method has been applied to an Apollo 9 frame and the sensor OTF has been calculated. The results are good enough to encourage use of the technique and to indicate the accuracies required of the various measurements involved in determining in-flight sensor OTF by this method. A technique for determining correct scan registration and scaling between the two sets of imagery and a promising approach to noise reduction, in the form of weighted averaging of OTF's, are discussed. A.L.

N73-11308*# Arizona Univ., Tucson.
EVALUATION OF ERTS-1 IMAGE SENSOR SPATIAL RESOLUTION IN PHOTOGRAPHIC FORM Progress Report
P. N. Slater, Principal Investigator and R. A. Schowengerdt Nov. 1972 4 p
(Contract NAS5-21849)
(E72-10213; NASA-CR-128484; PR-1) Avail: NTIS HC $3.00 CSCL 14E

There are no author-identified significant results in this report.

N73-11309*# National Marine Fisheries Service, Bay Saint Louis, Miss.
APPLICATION OF ERTS-1 FOR FISHERY RESOURCE ASSESSMENT AND HARVEST
William H. Stevenson, Paul M. Maughan, Principal Investigators (Earth Satellite Corp., Washington, D. C.), and Buddy H. Atwell [1972] 8 p
(Contract NAS5-21743; NASA Order S-70246-AG)
(E72-10215; NASA-CR-128486) Avail: NTIS HC $3.00 CSCL 08A

There are no author-identified significant results in this report.

N73-11310*# Corps of Engineers, Champaign, Ill.
EFFECTS OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 9 Aug. - 8 Oct. 1972
R. K. Jain, Principal Investigator 8 Oct. 1972 1 p Sponsored by NASA
(E72-10216; NASA-CR-128487) Avail: NTIS HC $3.00 CSCL 08H

There are no author-indentified significant results in this report.

N73-11311*# Corps of Engineers, Champaign, Ill.
EFFECT OF CONSTRUCTION AND STAGED FILLING OF RESERVOIRS ON THE ENVIRONMENT AND ECOLOGY Progress Report, 8 Jun. - 8 Aug. 1972
R. K. Jain, Principal Investigator 8 Aug. 1972 1 p Sponsored by NASA
(E72-10217; NASA-CR-128488) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report

N73-11312*# Earth Satellite Corp., Berkeley, Calif.
MINERAL EXPLORATION POTENTIAL OF ERTS-1 DATA Progress Report, May - Oct. 1972
William A. Brewer, Principal Investigator, M. C. Erskine, and R. O. Prindle 17 Nov. 1972 7 p refs
(Contract NAS5-21745)
(E72-10218; NASA-CR-129084) Avail: NTIS HC $3.00 CSCL 08G

The author has identified the following significant results. Preliminary analysis of a mosaic composing eight individual ERTS frames (1:1,000,000) extending well beyond the test site has revealed a number of tectonic structural trends that are controlled by regional lineations. So far most of the regional lineations fall into three general directions: east by northeast, northwest, and north-south. From preliminary examination, it appears that the older Precambrian basement predominates in the NE-bearing structural trends, whereas the predominate NW trend is most likely associated with the Texas Structural Zone, and the north-south trend being the Utah-Arizona belt and/or part of the southern Basin and Range Province. One major lineation, made up of many parallel lineations, is noticeable just north of Lake Pleasant which extends for approximately 100 miles in a northern direction out of the target area. This feature corresponds to a Precambrian schist formation shown on the USGS geologic map of Arizona.

N73-11313*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
INVENTORY OF FOREST AND RANGELAND AND DETECTION OF FOREST STRESS Progress Report, 1 Sep. - 31 Oct. 1972
Robert C. Heller, Robert C. Aldrich, Frederick P. Weber, and Richard S. Driscoll, Principal Investigators 8 Nov. 1972 11 p refs
(NASA Order S-70251-AG)
(E72-10219; NASA-CR-128485; PR-2) Avail: NTIS HC $3.00 CSCL 02F

There are no author-identified significant results in this report. Some ERTS-1 imagery has been received for each of the test sites: Black Hills, Atlanta, and Manitou. Only small portions of each site are covered and clouds have precluded capturing good imagery over the center of each site. Discoloration infestations of ponderosa pine are being located and sized on CIR transparencies. A computer program was completed from microdensitometer scans of CIR photos which maps areas of an image which are spectrally similar. Decided differences between forest types are present as well as differences between forest and other vegetative and nonvegetative land classes. A.L.

N73-11314*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
REMOTE SENSING IN RESOURCE EVALUATION, PLANNING, PROTECTION AND MANAGEMENT
Robert C. Heller, Arthur M. Woll, Principal Investigators (Bur. of Indian Affairs, Washington, D. C.), and Benjamin Spada 18 Oct. 1972 12 p Presented at 7th World Forestry Congr., Buenos Aires, 4-18 Oct. 1972
(NASA Order S-70251-AG)
(E72-10220; NASA-CR-129088) Avail: NTIS HC $3.00 CSCL 02F

There are no author-identified significant results in this report.

N73-11315*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.
REMOTE SENSING IN FORESTRY: PROMISES AND PROBLEMS
Robert C. Heller, Principal Investigator 4 Oct. 1972 16 p refs Presented at Natl. Meeting of the Soc. of Am. Foresters, Hot Springs, Ark., 4 Oct. 1972 Submitted for publication
(NASA Order S-70251-AG)
(E72-10221; NASA-CR-129089) Avail: NTIS HC $3.00 CSCL 02F

There are no author-identified significant results in this report.

N73-11316*# Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.

LAND USE CLASSIFICATION IN THE SOUTHEASTERN FOREST REGION BY MULTISPECTRAL SCANNING AND COMPUTERIZED MAPPING
Fred J. Thomson, Principal Investigator (Mich. Univ., Ann Arbor), F. P. Weber, R. C. Aldrich, and F. G. Sadowski (Mich. Univ., Ann Arbor) 6 Oct. 1972 1 p Presented at 8th Intern. Symp. on Remote Sensing of Environment, Ann Arbor, Mich., 6 Oct. 1972
(NASA Order S-70251-AG)
(E72-10222; NASA-CR-128489) Avail: NTIS HC #3.00 CSCL 08B

There are no author-identified significant results in this report.

N73-11317*# New York State Museum and Science Service, Albany.
EVALUATION OF ERTS IMAGERY AS A SPECTRAL GEOLOGICAL MAPPING TOOL IN NEW YORK STATE
Yngvar W. Isachsen, Principal Investigator 25 Oct. 1972 1 p Sponsored by NASA
(E72-10223; NASA-CR-129156) Avail: NTIS HC $3.00 CSCL 08G

There are no author-identified significant results in this report.

N73-11318*# National Environmental Satellite Service, Washington, D.C.
EVALUATION OF ERTS DATA FOR CERTAIN OCEANOGRAPHIC USES Semiannual Report, Apr. - Sep. 1972
Alan E. Strong, Principal Invesgitator Sep. 1972 4 p refs
(NASA Order S-70246-AG)
(E72-10224; NASA-CR-129157) Avail: NTIS HC $3.00 CSCL 08C

There are no author-identified significant results in this report.

N73-11319*# TRW Systems Group, Redondo Beach, Calif.
ERTS IMAGE DATA COMPRESSION TECHNIQUE EVALUATION Monthly Progress Report, period ending 1 Nov. 1972
Donald J. Spencer, Principal Investigator 3 Nov. 1972 1 p
(Contract NAS5-21746)
(E72-10226; NASA-CR-129159; TRW-7132.1-06) Avail: NTIS HC $3.00 CSCL 05B

There are no author-identified significant results in this report.

N73-11320*# Honeywell, Inc., St. Paul, Minn.
AUTOMATIC PHOTOINTERPRETATION FOR LAND USE MANAGEMENT IN MINNESOTA Progress Report
George D. Swanlund, Principal Investigator Oct. 1972 4 p
(Contract NAS5-21742)
(E72-10227; NASA-CR-129160; PR-3) Avail: NTIS HC $3.00 CSCL 14E

There are no author-identified significant result in this report.

N73-11321*# Oregon State Univ., Corvallis.
VEGETATION-TERRAIN FEATURE RELATIONSHIPS IN SOUTHEAST ARIZONA
Barry J. Schrumpf, Principal Investigator and David A. Mouat 27 Nov. 1972 19 p refs Presented at Intern. Conf. on Remote Sensing in Arid Lands
(Contract NAS5-21831)
(E72-10228; NASA-CR-129161) Avail: NTIS HC $3.00 CSCL 08F

There are no author-identified significant results in this report. Studies of relationships of vegetation distribution to geomorphic characteristics of the landscape and of plant phenological patterns to vegetation identification of satellite imagery indicate that there exists positive relationships between certain plant species and certain terrain features. Not all species were found to exhibit positive relationships with all terrain feature variables, but enough positive relationships seem to exist to indicate that terrain feature variable-vegetation relationship studies have a definite place in plant ecological investigations. Even more importantly, the vegetation groups examined appeared to be successfully discriminated by the terrain feature variables. This would seem to indicate that spatial interpretations of vegetation groups may be possible. While vegetational distributions aren't determined by terrain feature differences, terrain features do mirror factors which directly influence vegetational response and hence distribution. As a result, those environmental features which can be readily and rapidly ascertained on relatively small-scale imagery may prove to be valuable indicators of vegetation distribution. A.L.

N73-11322*# Wyoming Univ., Laramie. Dept. of Geology.
ANALYSIS OF ERTS IMAGERY OF WYOMING AND ITS APPLICATION TO EVALUATION OF WYOMING'S NATURAL RESOURCES Progress Report, Sep. - Oct. 1972
Robert S. Houston, Principal Investigator and Ronald W. Marrs Nov. 1972 10 p
(Contract NAS5-21799)
(E72-10229; NASA-CR-128490; ERTS-1-1-72B) Avail: NTIS HC $3.00 CSCL 08G

The author has identified the following significant results. The Wyoming ERTS investigation has been hindered only slightly by incomplete ERTS data sets and lack of coverage. Efforts to map cultural development, vegetation distributions, and various geomorphologic features are underway. Tectonic analysis of the Rock Springs area has isolated two linear features that may be very significant with regard to the regional structure of central Wyoming. Studies of the fracture systems of the Wind River Mountains are being completed. The fracture map, constructed from ERTS-1 interpretations, contains a great deal of structural information which was previously unavailable. Mapping of the Precambrian metasedimentary and metavolcanic terrain of the Granite Mountains is nearing completion, and interpretation of ERTS supporting aircraft data has revealed deposits of iron formation.

N73-11323*# Water Survey of Canada, Ottawa, (Ontario).
WATER SURVEY OF CANADA: APPLICATION FOR USE OF ERTS-A FOR RETRANSMISSION OF WATER RESOURCES DATA Progress Report
R. A. Halliday, Principal Investigator 17 Nov. 1972 10 p Sponosred by NASA Original contains color illustrations
(E72-10230; NASA-CR-129094; PR-1) Avail: NTIS HC $3.00 CSCL 08H

There are no author-identified significant results in this report.

N73-11324*# Tennessee Univ., Knoxville. Dept. of Electrical Engineering.
ERTS-A IMAGERY INTERPRETATION TECHNIQUES IN THE TENNESSEE VALLEY Progress Report, 25 Sep. - 25 Nov. 1972
Robert E. Bodenheimer, Principal Investigator 29 Nov. 1972 2 p Sponsored by NASA
(E72-10231; NASA-CR-129105) Avail: NTIS HC $3.00 CSCL 08F

There are no author-identified significant results in this report.

N73-11325*# Purdue Univ., Lafayette, Ind. Lab. for Application of Remote Sensing.
EVALUATION AND COMPARISON OF ERTS MEASUREMENTS OF MAJOR CROPS AND SOIL ASSOCIATIONS FOR SELECTED SITES IN THE CENTRAL UNITED STATES Bimonthly Progress Report, 1 Sep. - 31 Oct. 1972
Marion F. Baumgardner, Principal Investigator 31 Oct. 1972 3 p Sponsored by NASA
(E72-10232; NASA-CR-129106) Avail: NTIS HC $3.00 CSCL 08F

There are no author-identified significant results in this report.

N73-11326*# National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.
REMOTE SENSING OF OCEAN CURRENTS Interim Report, May. - Nov. 1972
George A. Maul, Principal Investigator Nov. 1972 8 p
(NASA Order S-70246-AG)
(E72-10233; NASA-CR-129107) Avail: NTIS HC $3.00 CSCL 08C

The author has identified the following significant results. Monthly field experiments in support of the NOAA investigation of ocean color boundary determination using ERTS data have been conducted since June 1972. The color boundary between the Loop Current and coastal water has been detected by airborne cameras with ERTS type bandpass filters, at altitudes of 7300 meters. Ship and aircraft data hint that the boundary may be enhanced due to increased phytoplankton populations caused

by convergence of the surface waters. The term edge effect has been coined to describe this phenomenon.

N73-11327# Weapons Research Establishment, Salisbury (Australia).
TURBULENCE, BILLOWS AND GRAVITY WAVES IN A HIGH SHEAR REGION OF THE UPPER ATMOSPHERE
K. H. Lloyd, C. H. Low, and R. A. Vincent (Adelaide Univ.) Jun. 1972 26 p refs
(WRE-TN-670(WR/D)) Avail: NTIS HC $3.50

Observations on the behavior of a trail of lithium vapor released on the downleg trajectory from a rocket at Woomera from 150 to 92 km are presented. The firing was at 0440 CST, 6 November 1970, in morning twilight when the earth's shadow was at 130 km. Although this prevented observations being made on the early development of turbulence in the trail, it enabled the cloud to be photographed for longer than is usual, before its emissions were swamped by the light of the sky. Very interesting features developed in the trail at late times, especially in a region of high shear at 107 km. Author

N73-11328# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
[FIELD AND LABORATORY STUDIES, SERVICES, AND PUBLICATIONS ON GEOLOGY, GEOPHYSICS, AND MINERAL RESOURCES] Annual Report, 1971
1972 104 p refs
Avail: NTIS HC $7.25

Data are presented on regional geochemistry, sedimentalogy, ore genesis, volconalogy, and geochonology. Geophysical studies cover design and development of instruments, experimental surveys to evaluate techniques, palaneomagnetism, and mathematical research with evaluation and interpretation. Geological mapping standards are also given. The regional areas studied were Northern and Western Australia and Papua New Guinea. Major exploration was made for evaporite deposites. Author

N73-11329# Institut d'Aeronomie Spatiale de Belgique, Brussels.
ON THE VERTICAL DISTRIBUTION OF CARBON MONOXIDE AND METHANE IN THE STRATOSPHERE
M. Nicolet and W. Peetermans 1972 39 p refs
(A-N-103-1972) Avail: NTIS HC $4.00

The vertical distribution of the methane concentration in the stratosphere is related to its dissociation by two simultaneous daytime reactions with excited oxygen atoms O(1D) and with OH radicals and depends on the stratospheric eddy diffusion coefficient. Dissociation of CH4 in the lower stratosphere leads to the production of CO molecules, while in the upper stratosphere the photodissociation of CO2 molecules is an additional process to the CO production. In the upper stratosphere there is an equilibrium between the formation and destruction processes of carbon monoxide which leads to a minimum of its mixing ratio. There is an increase of the CO mixing ratio in the troposphere and mesosphere compared with that of the stratosphere.
Author

N73-11330# Institut d'Aeronomie Spatiale de Belgique, Brussels.
STRATOSPHERIC NITROGEN DIOXIDE FROM INFRARED ABSORPTION SPECTRA
M. Ackerman and C. Muller 1972 9 p refs Submitted for publication
Avail: NTIS HC $3.00

Stratospheric absorption spectra of nitrogen dioxide were interpreted quantitatively. NO2 mixing ratios from 12 to 28 km are presented. Author

N73-11331# Research Inst. of National Defence, Stockholm (Sweden).
REFLECTION OF SOUND WAVES FROM THE SEA BED WITH SPECIAL REFERENCE TO CONDITIONS IN THE BALTIC SEA
Tore Pentelius Aug. 1971 18 p refs In SWEDISH; ENGLISH summary
(FOA-3-C-3680-E1) Avail: NTIS HC $3.00

Beginning with the theory of reflection from stratified media taking into account their absorption, a model was constructed which embodies their known geological and physical parameters. Since these are not completely defined for the Baltic Sea, it is of interest to examine how these uncertainties influence the reflection characteristics. With the help of computer calculations, it is shown that the properties of the sedimentary layer are most significant and that measurements of speed of sound, density, and absorption by the sediment should be made. Author

N73-11332# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
INFORMATION RELATIVE TO CARTOGRAPHY AND GEODESY. SERIES 2: GERMAN CONTRIBUTIONS IN FOREIGN LANGUAGES, NO. 27
1972 108 p refs
Avail: NTIS HC $7.50

Photogrammetric computer programs reported use independent models and block point adjustment in aerotriangulation mapping.

N73-11333 Technische Hochschule, Stuttgart (West Germany).
AEROTRIANGULATION WITH INDEPENDENT MODELS
F. Ackermann *In* Inst. fuer Angew. Geodaesie Inform. Relative to Cartography and Geodesy, ser. 2, no. 27 1972 p 5-20 refs (For availability see N73-11332 02-13)

The development of computer programs for aerotriangulation with independent models, experiments and programmetric considerations have led to a direct solution for the respective normal equations with few linearizations. Obtained programs confirm the feasibility of practical block and strip triangulations for cadastral photogrammetry. G G

N73-11334 Technische Hochschule, Stuttgart (West Germany).
A COMPUTER PROGRAMME FOR STRIP TRIANGULATION WITH INDEPENDENT MODELS
F. Ackermann, H. Ebner, and H. Klein *In* Inst. fuer Angew. Geodaesie Inform. Relative to Cartography and Geodesy, ser. 2, no. 27 1972 p 21-38 refs (For availability see N73-11332 02-13)

The principles and the performance of a computer program which is available in ALGOL and FORTRAN for strip adjustment by the method of independent models is described. It carries out strip formation, strip transformation and a rigorous least squares adjustment by a simultaneous solution for all transformation parameters by the Cholesky method. The solution usually requires three iteration cycles. The comparison of a direct solution with an iterative solution by the method of conjugate gradients of the reduced normal equations is made with the results in favor of the direct solution. On the Telefunken TR 4 computer strips of up to 70 models can be treated. Using the Control Data computer CDC 6600 much longer strips may be adjusted. The computing time is about 10 sec per model on the TR 4 and 0.4 seconds on the CDC 6600. Author

N73-11335 Technische Hochschule, Stuttgart (West Germany).
A PROGRAMME PACKAGE FOR BLOCK ADJUSTMENT WITH INDEPENDENT MODELS
F. Ackermann, H. Ebner, and H. Klein *In* Inst. fuer Angew. Geodaesie Inform. Relative to Cartography and Geodesy, ser. 2, no. 27 1972 p 39-51 refs (For availability see N73-11332 02-13)

A program package for block triangulation (x, y, z) with independent models is presented. First the general requirements for adjustment of very large systems are listed, then the subprogramme HYCHOL for the solution of systems of equations of any size is discussed. Finally the adjustment program PAT-M 43 is reviewed, which operates with planimetry-height iterations. The computing times given demonstrate the high performance of the system. Author

N73-11336 Technische Hochschule, Stuttgart (West Germany).
THE THEORETICAL HORIZONTAL ACCURACY OF ADJUSTED BLOCKS OF UP TO 10,000 INDEPENDENT MODELS
H. Ebner *In* Inst. fuer Angew. Geodaesie Inform. Relative to Cartography and Geodesy, ser. 2, no. 27 1972 p 52-61 refs (For availability see N73-11332 02-13)

The investigation comprises seven square blocks of different sizes, in which the number of strips varies between 10 and 70 in steps of ten. The number of models ranges therefore between 200 and 9,800. The control points are arranged uniformly at the periphery of the block with a distance of two base lengths

between points. The standard error of the coordinates of selected tie points in units of the standard error of unit weight for blocks of 10, 30, 50 and 70 strips are shown. The equality of sigma sub x and sigma sub y is a characteristic of the anblock method in connection with the simple stochastic model on which it is based. Considering the slight accuracy differences within the individual blocks, it appeared sufficient to indicate the standard errors of only 81 tie points in a regular 9 x 9 grid. Since each block has two axes of symmetry, it is also sufficient to show a quarter of the block and thus the standard errors of 25 tie points only. Author

N73-11337 Technische Hochschule, Stuttgart (West Germany).
HORIZONTAL BLOCK ADJUSTMENT WITH LARGE NUMBERS OF POINTS
F. Ackermann *In* Inst. fuer Angew. Geodaesie Inform. Relative to Cartography and Geodesy, ser. 2, no. 27 1972 p 62-75 refs (For availability see N73-11332 02-13)

Comparison between indivldual model restitution and block adjustment methods for photogrammetric cadastral mapping shows that the block adjustment method is more homogeneous within itself. In the block, the mean value of the gaps at model transitions is very effectively reduced by more than half (58%). Conversely it is shown that the fit of the models to the tie points becomes worse by 30% in the block. Results prove that block triangulation can replace individual model restitution. A method using existing trigonometric points plus edge control points is particularly suitable for cadastral surveys with reallotment operations. G.G.

N73-11338 Technische Hochschule, Stuttgart (West Germany).
COMBINED PHOTOGRAMMETRIC-TERRESTRIAL CADASTRAL SURVEYING
K. Kraus and R. Bettin *In* Inst. fuer Angew. Geodaesie Inform. Relative to Cartography and Geodesy, ser. 2, no. 27 1972 p 76-92 refs (For availability see N73-11332 02-13)

In general, photogrammetry cannot quite meet the high relative accuracy officially specified for cadastral surveys in the Federal Republic of Germany. Satisfactory accuracy is achieved, however, if short distances and other data measured in the terrain are included in the calculation of the final coordinates. Besides augmenting accuracy, these ground data also have the important function of providing a thorough test for all coordinates. The ALGOL program is described and the practical results of a large combined photogrammetric-terrestrial cadastral survey are reported. Author

N73-11339 Technische Hochschule, Stuttgart (West Germany).
AEROTRIANGULATION WITH INDEPENDENT MODELS ON THE ZEISS PLANIMAT: A STUDY OF THE INSTRUMENT
H. Ebner and W. Wagner *In* Inst. fuer Angew. Geodaesie Inform. Relative to Cartography and Geodesy, ser. 2, no. 27 refs (For availability see N73-11332 02-13)

The Zeiss Planimat is suitable for triangulation with independent models. The coordinates of the perspective centers can be determined by two different methods. The interior accuracy of the two methods is studied by repeated measurement of grid models including the perspective centers. In addition, the systematic instrument errors in the wide-angle and ultra-wide-angle positions for near-horizontal and tilted photographs are determined. Finally, the effect of these errors on strip triangulation is shown. The resulting accuracy of the instrument justifies the expectation of good results in practical triangulation work. Author

N73-11340*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NEUTRAL WINDS ABOVE 200Km AT HIGH LATITUDES
J. W. Meriwether, J. P. Heppner, J. D. Stolarik, and E. M. Wescott Oct. 1972 40 p refs
(NASA-TM-X-66083; X-645-72-401) Avail: NTIS HC $4.00 CSCL 03B

Motion from multiple chemical releases between 200 and 300 km from 15 rockets launched from 4 high latitude locations are analyzed. The observations in the evening and midnight hours at magnetic altitudes > or = 65 deg suggest that in these regions ion drag is the dominant force in driving neutral winds between 200 and 300 km. This conclusion is based on both the agreement between ion and neutral drift directions, and the fact that there are distinct changes in the wind associated with (a) the reversal in east-west ion drift at the Harang discontinuity, and (b) the transition from auroral belt, sunward ion drift and polar cap, anti-solar ion drift. Author

N73-11341*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE LIGHT ION TROUGH, THE MAIN TROUGH, AND THE PLASMAPAUSE
Harry A. Taylor, Jr. and William J. Walsh (Aero Geo Astro Corp., College Park, Md.) Aug. 1972 27 p refs Submitted for publication
(NASA-TM-X-66089; X-621-72-422) Avail: NTIS HC $3.50 CSCL 04A

Extensive observations of mid-latitude depletions in electron and total ion density by both direct and indirect techniques, have prompted numerous studies of the possible association between these troughs, observed in the F-region, the topside ionosphere, and the plasmapause. One basic problem arises, in that while the plasmapause was detected as a global phenomenon both by VLF and ion composition measurements, the electron and ion density troughs were identified primarily as nightside features. This problem, as well as the difficulty in explaining various inconsistencies in relating the position of the plasmapause and the ionization trough, is explained by a close examination of the ion composition. In particular, ion composition results from the polar orbiting OGO satellites identify the persistence of a pronounced light ion trough in H(+) and He(+) identified by order of magnitude decreases in the light ion concentrations. Author

N73-11342*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE GEOCENTRIC ORIENTATION VECTOR FROM LIMITED ASTRO-GEODETIC DATA
R. S. Mather Oct. 1972 16 p refs Submitted for publication
(NASA-TM-X-66078; X-553-72-378) Avail: NTIS HC $3.00 CSCL 08N

Test computations using the comprehensive sets of both astro-geodetic and gravimetric data indicate that the accuracy of the geocentric orientation vector determined from incomplete representations of the earth's gravitational fields, is dependent on the overall extent of the datum. The lack of an astro-geodetic determination of the geoid due to an inadequate density of astro-geodetic stations over certain parts of the datum does not materially affect these determinations. The effect is only marginal if the station density of the area referred to does not markedly differ from the average for the region. Author

N73-11343# Michigan Univ., Ann Arbor. Willow Run Labs.
A STUDY OF WATER FOWL HABITAT IN NORTH DAKOTA USING REMOTE SENSING TECHNIQUES Final Report, 1 May 1969 - 31 Jan. 1970
W. G. Burge and W. L. Brown Jul. 1970 71 p refs Original contains color illustrations
(Contract USGS-14-08-0001-11950)
(USGS-IR-215) Avail: NTIS HC $5.75; USGS

Airborne multispectral data were gathered at two altitudes (2000 ft and 10,000 ft above terrain) for the U.S. Geological Survey in May 1968 using the optical-mechanical scanner over waterfowl nesting habitat near Jamestown, North Dakota. Subsequent data analysis was conducted to assess the feasibility of obtaining indirectly an estimate of annual waterfowl production using current remote sensing technology. Experiments on this data demonstrated the ability of analog and digital computer-implemented instrumentation to recognize and map selected materials and/or features on the basis of their spectral characteristics. Most of the recognition work was performed with a special-purpose analog computer. Recognition of materials, such as pond water, marsh vegetation, bare soil, upland vegetation, and cultural features, using the low altitude data, was quite successful. Using high altitude data was moderately successful in automatically recognizing pond water, bare soil, upland vegetation, and cultural features. From the low altitude data, statistical summaries and distributions of pond area, pond perimeter, and pond shape were obtained by performing digital

operations on recognition data and seem more accurate than measurements from aerial photographs. Author

N73-11344*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A POSSIBLE SHOCK EFFECT ASSOCIATED WITH SEA-QUAKES
J. Quann, I. Eberstein, and S. Curtis [1972] 21 p refs
(NASA-TM-X-66096; X-621-72-386) Avail: NTIS HC $3.25 CSCL 08K

The effects of earthquakes felt on board vessels at sea are discussed along with the possibility of cohesive shock wave propagating through the ocean. The large earthquake of shallow focus which occurred on 29 April 1970, in the Guatemala Basin is analyzed. The thermal information recorded by ITOS-1 spacecraft showed an anomalous temperature enhancement of +3 K in the immediate vicinity, indicating a thermal effect attributed to shock waves. F.O.S.

N73-11345*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SEASONAL AND ALTITUDE VARIATIONS IN FIELD-ALIGNED PRECIPITATION OCCURRENCE
F. W. Berko Oct. 1972 24 p refs
(NASA-TM-X-66099; X-646-72-405) Avail: NTIS HC $3.25 CSCL 04A

Data from more than 7500 orbits of the polar-orbiting satellite OGO-4 have been analyzed to determine the existence of seasonal, altitude, or universal time differences in the occurrence of field-aligned electrons. Unexpected variations in frequency of occurrence have been found at different altitudes and in different seasons. In particular, the probability of observing this phenomenon at high latitudes was found to be greatest in the winter months at the highest altitudes attained by OGO-4. A localized parallel electric field acceleration mechanism is presented which could account for the particle observations. Author

N73-11346*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NOTE ON THE SEMI-ANNUAL EFFECT IN THE THERMOSPHERE
H. Volland (Bonn Univ.) and H. G. Mayr Nov. 1972 12 p refs Submitted for publication
(NASA-TM-X-66100; X-621-72-416) Avail: NTIS HC $3.00 CSCL 04A

The semi-annual variation in the thermospheric density is discussed in terms of the spatial and temporal variations in the solar heat input. Two heat sources are considered: the solar heat input associated with the semi-annual migration of the sun, and the auroral heat associated with the semi-annual component in magnetic storms. It is shown that the relatively large global component in the semi-annual effect of the total mass density can be explained by the lack of advective loss which otherwise damps the latitude dependent components in the annual and semi-annual variations, and the significant latitude dependence in the semi-annual variations of composition and temperature can be tied to the diffusion process which is induced by the thermospheric circulation. F.O.S.

N73-11347*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
VERY HIGH-FREQUENCY (VHF) IONOSPHERIC SCINTILLATION FADING MEASUREMENTS AT LIMA, PERU
Howard A. Blank (Computer Sci. Corp.) and Thomas S. Golden May 1972 26 p refs Presented at 1972 USNC/URSI-IEEE Spring Meeting, Washington, D. C., 13-15 Apr. 1972
(NASA-TM-X-66092; X-810-72-177) Avail: NTIS HC $3.50 CSCL 04A

During the spring equinox of 1970, scintillating signals at VHF (136.4 MHz) were observed at Lima, Peru. The transmission originated from ATS 3 and was observed through a pair of antennas spaced 1200 feet apart on an east-west baseline. The empirical data were digitized, reduced, and analyzed. The results include amplitude probability density and distribution functions, time autocorrelation functions, cross correlation functions for the spaced antennas, and appropriate spectral density functions. Results show estimates of the statistics of the ground diffraction pattern to gain insight into gross ionospheric irregularity size, and irregularity velocity in the antenna planes. Author

N73-11348# Illinois State Water Survey, Urbana.
RESEARCH NEEDS ON WASTE HEAT TRANSFER FROM LARGE SOURCES INTO THE ENVIRONMENT
Dec. 1971 41 p
(Grant NSF GI-30971)
Avail: NTIS HC $4.25

A conference was held to evaluate research needs on problems of waste heat transfer from large thermal sources, such as electric generating plants, into the environment. A group of 27 experts from a broad cross section of professional activities reviewed the knowledge of present and projected environmental effects resulting from large injections of waste heat into the environment by means of wet and dry cooling towers and cooling ponds, lakes, and streams. Complicated interactions of the physical, engineering, biological, social, and economic factors are discussed in this report which focuses on key problem areas and suggests needs and directions for further research and action. Various alternatives for waste heat disposal are listed. Alternatives relative to various climatic regimes and local resources in order that environmental consequences might be minimized without excessive delays and costs are reviewed. Author

N73-11349# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE DETERMINATION OF THE GROUP PATH DIFFERENCE BY AN INTERFERENCE METHOD
V. A. Rybin 1972 2 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 12, no. 4, 1972 p 764-766
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

Frequency swinging method applied to ionospheric investigations, obtaining the difference in the group paths of ordinary and extraordinary reflected waves is discussed. The difference in the paths between propagation modes for microwave multipathing is determined by an analogous expression. J.A.M.

N73-11350# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE CURRENT INSTABILITY IN THE NEUTRAL LAYER OF THE EARTH'S MAGNETOSPHERE TAIL
O. A. Pokhotelov 1972 6 p refs Transl. into ENGLISH from Geomagnetizm i Aeronomiya (Moscow), v. 12, no. 4, 1972 p 693-698
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The anisotropic instability of a plasma without a permanent magnetic field is examined. It is shown that a plateau in the low velocity domain is formed in the electron distribution function because of quasilinear plasma relaxation. The results of the theory are used to analyze the current stability in the neutral layer of the earth's magnetosphere tail. It is also shown that current plays the part of the anisotropy for this case. Author

N73-11351*# Danish Meteorological Inst., Charlottenlund.
CRITICAL COMPONENT OF THE INTERPLANETARY MAGNETIC FIELD RESPONSIBLE FOR LARGE GEOMAGNETIC EFFECTS IN THE POLAR CAP
E. Friis-Christensen, K. Lassen, J. Wilhjelm, J. M. Wilcox, W. Gonzalez (Stanford Univ., Calif.), and D. S. Colburn (NASA Ames Res. Center) 1972 24 p refs
(Grant NGL-05-003-230; Contract N00014-67-A-0112-068; Grant NSF GA-31138)
(NASA-CR-129165; DMI-Geophys-Papers-R-30) Avail: NTIS HC $3.25

An observed influence is studied of the interplanetary magnetic sector structure on the geomagnetic variations in the polar cap which appears to be due to the component of the interplanetary magnetic field near the ecliptic perpendicular to the earth-sun direction. It is suggested that the observed effect on the ground originates in the front of the magnetosphere. Author (ESRO)

N73-11352# Institut Royal Meteorologique de Belgique, Brussels.
IONOSPHERIC AND COSMIC RAY OBSERVATIONS Monthly Bulletin, Mar. 1972 [OBSERVATIONS IONOSPHERIQUES ET DU RAYONNEMENT COSMIQUE BULLETIN MENSUEL, MARS 1972]

Mar. 1972 31 p In FRENCH and DUTCH
Avail: NTIS HC $3.75

Results of ionospheric and cosmic ray (neutron component) observations at Dourbes (Belgium) are tabulated for March 1972. ESRO

N73-11353# Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA: DATA SUMMARY 72/1-3, JANUARY-MARCH 1972
L. Liszka, ed. Mar. 1972 129 p Prepared jointly with European Space Sounding Rocket Range
Avail: NTIS HC $8.50

Data recorded at Kiruna relating to geomagnetic variations and storms, earth currents, auroras, cosmic noise, and ionospheric absorption are presented. Measurements include geomagnetic K-indices, all-sky camera records, and vertical incidence ionospheric soundings. Magnetograms, riometer recordings, and routine ionograms from the down range station are reproduced.
Author (ESRO)

N73-11354# Danish Meteorological Inst., Charlottenlund.
ON THE CLASSIFICATION OF HIGH-LATITUDE AURORAS
Knud Lassen 1972 48 p refs Submitted for publication
(DMI-Geophys-Papers-R-28) Avail: NTIS HC $4.50

Polar graphs showing the distribution of mean auroral frequencies as observed from a network of all-sky cameras in Greenland are presented for values of kp from 0 to 5. The grouping of the frequencies in the plots and the dependence of this on kp as well as on the sunspot activity is discussed. Details are presented from single nights. With support from a position survey in the polar graph of observed areas and bands at kp = 1, a model of the auroral grouping is inferred which gives the main precipitation curves as a spiral-like figure situated in the morning at 75-80 deg and in the evening at 65-70 deg.
Author (ESRO)

N73-11355# Danish Meteorological Inst., Charlottenlund.
INTERPLANETARY MAGNETIC SECTOR STRUCTURE, 1926-1971
L. Svalgaard 1972 39 p refs
(DMI-Geophys-Papers-R-29) Avail: NTIS HC $4.00

The directional influence of the interplanetary magnetic field on the geomagnetic field at high latitudes is used to study the long term behavior of the sector structure during nearly four solar cycles. It is found that the rotation period of the sector structure varies from about 28.5 days in the beginning of a solar cycle to 27.0 days at the end. Also it is shown that short-lived sectors rotate slower than long-lived ones.
Author (ESRO)

N73-11356# Danish Meteorological Inst., Charlottenlund.
NARSSARSSUAQ GEOPHYSICAL OBSERVATORY: MAGNETIC RESULTS, 1968 - 1970 (INSTRUMENTATION AND FORMULAS)
1972 23 p refs
Avail: NTIS HC $3.25

Regular recordings of the 3 magnetic elements H, D, and Z, using photographic variometers at Narssarssuaq Geophysical Observatory during the period 1968-1970, are given. The determination of baseline values and reduction formulas are described.
Author (ESRO)

N73-11357# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et de ses Applications Spatiales.
APPLICATION OF THE LEAST SQUARES METHOD TO PARAMETERIZATION [APPLICATION DE LA METHODE DES MOINDRES CARRES A LA RECHERCHE DE PARAMETRES]
J. P. Gouyon May 1972 15 p refs In FRENCH
(LAAS-NT-SIS-72-T-08) Avail: NTIS HC $3.00

A least squares method is described which determines an unknown parameter vector from measurements. This method permits identification, in the p dimension space of the vector Q, of a region containing the extremity of this vector with a certain probability (95%). The problem can then be solved by means of the estimation of confidence intervals, and this method has led to the development of computer programs which can be applied to 3, 4, and 5 parameter cases.
Author (ESRO)

N73-11358# Environmental Prediction Research Facility (Navy), Monterey, Calif.
A DESCRIPTION OF THE ENVIRONMENTAL PREDICTION RESEARCH FACILITY HYDRODYNAMICAL-NUMERICAL MODEL: APPENDICES
Mar. 1972 35 p
(AD-745760; ENVPREDRSCHFAC-TP-3A-72) Avail: NTIS CSCL 08/3

The document comprises the appendices to AD-745759. These appendices are as follows: Input parameters, formats and set-up of tapes; Abbreviations and parameters used in the program; The program for the hydrodynamical-numerical model in FORTRAN 2.
Author (GRA)

N73-11359# Lowell Technological Inst. Research Foundation, Mass.
DIGITAL IONOSONDE FOR MONITORING THE IONOSPHERE Final Scientific Report, 28 Mar. 1969 - 31 Jul. 1971
Klaus Bibl, Joseph A. Patenaude, and Bodo W. Reinisch May 1972 280 p refs
(Contract F19628-69-C-0155; AF Proj. 5631)
(AD-745965; LTIRF-341/IP; AFCRL-71-0507) Avail: NTIS CSCL 04/1

Many years experience in ionospheric physics as well as design and operation of ionospheric sounders were the basis for creation of the Digisonde 128. By implementing the latest achievements in state of the art technology and recent advancements in solid state analog components and digital arrays, a technically sophisticated ionosonde has been realized. Although the main feature of the Digisonde 128 is the continuous monitoring of the ionosphere by vertical pulse sounding in a large frequency range, it has many features which make it the most versatile instrument of its kind. Continuous recording of ionospheric absorption at many frequencies makes this sounder a unique geophysical tool.
Author (GRA)

N73-11360# Arcon Corp., Wakefield, Mass.
MATHEMATICAL AND STATISTICAL ANALYSIS FOR THE REDUCTION OF IONOSPHERIC DATA
Manfred Friedman, David C. Miller, and Arnold Reinhold Jan. 1972 61 p refs
(Contract F19628-71-C-0034)
(AD-745966; AFCRL-72-0130; SR-1) Avail: NTIS CSCL 04/1

The report describes the techniques and programs developed to analyze various problems involving ionospheric physics. The main task consisted of the reduction and analysis of a large number of ionograms taken at various stations during the same time period. Programs were developed to perform statistical analysis on the data and to construct continuous models of the ionosphere based on these experimental observations. In connection with the development of these models, programs were designed and written to trace electromagnetic rays through different ionospheric models.
Author (GRA)

N73-11361# Texas Instruments, Inc., Dallas. Services Group.
EXTENDED ARRAY EVALUATION PROGRAM. SPECIAL REPORT NO. 5. PRELIMINARY EVALUATION OF THE NORWEGIAN LONG PERIOD ARRAY
John S. Eyres, Philip R. Laun, and William H. Swindell 30 Apr. 1972 167 p refs
(Contract F33657-71-C-0843; ARPA Order 1714; AFTAC Proj. VT/1705)
(AD-746009; TI-SR-5) Avail: NTIS CSCL 17/10

The report presents results from the preliminary evaluation of the long-period Norwegian Seismic Array. Signal and noise characteristics, array processing performance, matched and chirp filtering performance, detection threshold estimation, and discriminant behavior are discussed.
Author (GRA)

N73-11362# SACLANT ASW Research Center, La Spezia (Italy).
THE NUMERICAL SOLUTION OF PARABOLIC EQUATIONS APPLIED TO EDDY DIFFUSION IN THE OCEAN
Hans R. Krol 1 Jun. 1972 45 p refs

(AD-746205; SACLANTCEN-TM-178) Avail: NTIS CSCL 08/10

The paper describes the main features of the numerical solution of parabolic partial differential equations with particular application to the eddy heat conduction problem in the ocean. As an example, some direct calculations are made of the eddy heat conduction coefficient from the data of MILOCMED 68 under the assumption that there were no horizontal gradients. Although the assumption does not in general hold it serves to provide a simplified but plausible model to illustrate the numerical techniques. A restricted discussion of the results is given.

Author (GRA)

N73-11363# Aerospace Corp., El Segundo, Calif.

ABSORPTION OF THE 4 TO 6 mm WAVELENGTH BAND IN THE ATMOSPHERE Technical Report, Jul. 1969 - Jun. 1971

Earl E. Reber 15 Mar. 1972 50 p refs

(Contract F04701-71-C-0172)

(AD-745951; TR-0172(2230)-6; SAMSO-TR-72-151) Avail: NTIS CSCL 04/1

The analysis of an extensive series of zenith attenuation measurements of the atmosphere on both sides of the oxygen absorption spectrum (48 to 72 GHz) elucidates the absorption characteristics of the 4- to 6-mm wavelength band. With the sun as a source, zenith attenuation measurements were made and used as a function of the precipitable water content of the atmosphere to determine the zenith attenuation coefficients of precipitable water. From these coefficients and measurements of the total precipitable water in the atmosphere, the oxygen components of the zenith attenuation were determined. The zenith oxygen attenuations as a function of frequency and altitude are used to compare the theories for collision-broadened spectral lines and to develop a new expression for pressure-broadened spectral lines. Author (GRA)

N73-11364# Ohio State Univ., Columbus. Dept. of Geodetic Sciences.

TWO FORTRAN 4 COMPUTER PROGRAMS FOR THE GENERAL COMBINATION OF SATELLITE AND GRAVITY DATA FOR POSITION AND GRAVITY FIELD DETERMINATORS Interim Report

S. Gopalapillai, Pentti Karki, and Richard Rapp Feb. 1972 57 p refs

(Contract F19628-69-C-0127; AF Proj. 7600)

(AD-746305; DGS-168; AFCRL-72-0142; SR-22) Avail: NTIS CSCL 08/5

Previous work on the general combination procedure has been extended to include datum rotation and datum scale parameters. The new equations have been incorporated into two computer programs that are described in the report. The first program incorporates satellite derived station coordinates and data from gravimetrically oriented stations to find a consistent set of datum parameters, geocentric coordinates of various stations, and an equatorial radius. In the second program, potential coefficients are added as unknowns and deflections of the vertical and height anomaly information is directly input to the program. Author (GRA)

N73-11365# Rochester Univ., N.Y.

GENERALIZED SLAB MODEL AND FINITE LARMOR RADIUS EFFECTS Semiannual Technical Report, 15 Sep. 1971 - 14 Mar. 1972

Jeng-Nan Shiau and Albert Simon Apr. 1972 25 p refs

(Contract F30602-70-C-0001; ARPA Order 1057)

(AD-746060; RADC-TR-72-147) Avail: NTIS CSCL 04/1

An equilibrium slab model of a barium cloud is derived. This model has finite length in the magnetic field direction and allows one to study the stability of configurations with various degrees of ionospheric short-circuiting. It reduces to previous models for the case of no short-circuiting but is quite different in the more general case. The combined influence of finite Larmor radius corrections and inertia on the stability of the infinite slab model is studied. A simple dispersion relation is obtained.

Author (GRA)

N73-11366# Naval Ship Research and Development Center, Annapolis, Md.

OPTICAL PHASE AND INTENSITY FLUCTUATIONS IN A REFRACTIVE INDEX MICROSTRUCTURE: A MATHEMATICAL ANALYSIS

Alan S. Fields Jul. 1972 64 p refs

(ZR0010101)

(AD-746120; NSRDC-6-196; NSRDC-3577) Avail: NTIS CSCL 08/10

Studies have been published which extend and apply the Kolomogorov theory of turbulence to the fluctuations of optical refractive index in the ocean due to salinity and temperature microstructure. Mathematical models of some of the statistical properties of these fluctuations are developed to provide continuous functions obeying the various Fourier transform relationships provided by the studies. The continuous functions are used to characterize the phase and intensity fluctuations of a plane, monochromatic optical wave passes through such a turbulent medium. The knowledge of the relationship between fluctuations of the optical parameters and the refractive index microstructure provides a basis for the use of laser beams as data links or in studies of the propagating medium.

Author (GRA)

N73-11367# Rosenstiel School of Marine and Atmospheric Sciences, Miami, Fla.

ON THE INFLUENCE OF BOTTOM FRICTION ON TRANSIENT BAROCLINIC WIND RESPONSE

Walter Dueing, Claes Rooth, and Sylvia Worthem Jul. 1972 57 p refs

(Contract N00014-67-A-0201-0013; NR Proj. 083-060)

(AD-746506; UM-RSMAS-72061) Avail: NTIS CSCL 08/3

Analytical experiments were conducted to determine the spectral response of a two layer, beta-plane ocean of rectangular shape. The model provides time-dependent wind stress and bottom friction as driving forces. For damping coefficients mu is less than 10 to -8th power/sec, the dispersion relation is essentially the same as for the undamped case for wave periods of one year or less. Larger values of mu significantly after the dispersion relation for short barotropic waves, causing the corresponding branch to intersect with that of the short baroclinic waves. Author (GRA)

N73-11368# Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology.

NONLINEAR INTERACTIONS AMONG STANDING SURFACE AND INTERNAL GRAVITY WAVES Ph.D.Thesis

Terrence Michael Joyce Jun. 1972 101 p refs Prepared in cooperation with Woods Hole Oceanog. Inst., Mass.

(Contract N00014-67-A-0204-0048; Grant NSF GA-30616; NR Proj. 083-157)

(AD-746138; Rept-72-3; GFD-72-3) Avail: NTIS CSCL 08/3

A laboratory study was undertaken to measure the momentum transfer from surface to internal gravity waves in a nonlinear, resonant interaction. The interacting waves form triads for which (Sigma sub is)-(Sigma sub 2S) plus or minus (Sigma sub I) = 0 and (Kappa sub is)-(Kappa sub 2S) plus or minus (Kappa sub I) = 0; Sigma sub j and Kappa sub j being the frequency and wavenumber of the jth wave. In particular, the experiment is designed to model a generating mechanism for high frequency, oceanic internal waves. Unlike previously published results involving single triplets of interacting waves, all waves here considered are standing waves. The growth to steady state of a resonant internal wave is observed while two deep water surface eigen modes are simultaneously forced by a paddle. Results are compared to theoretical predictions which assume, ab initio, all waves to be standing. Inclusion of viscous side wall dissipation and slight detuning permit predictions of steady state amplitudes and phases as well as initial growth rates.

Author (GRA)

N73-11369# Massachusetts Inst. of Tech., Cambridge. Geophysical Fluid Dynamics Lab.

LONG NONLINEAR INTERNAL WAVES AND QUASI-STEADY LEE WAVES Ph.D. Thesis

Chi-yuan Lee Jun. 1972 130 p refs Prepared in cooperation with Woods Hole Oceanog. Inst.

(Contract Nonr-1841(74))

(AD-746137; GFD/72-2) Avail: NTIS CSCL 08/3

Previous observation of large amplitude internal gravity waves

generated by tidal flow over a submarine ridge in Massachusetts Bay have motivated the author to consider the general problem of internal gravity wave generation by time-dependent flow of a stratified, inviscid fluid over topography. An internal Korteweg and deVries type equation for the stream function is derived using a three parameter expansion method, where the three small parameters correspond to nonlinear, dispersive, and non-Boussinesq effects. Simple analytic models and laboratory experiments are used to examine mixing and the generation of quasi-steady lee waves. A tall, rapidly oscillating ridge acts to mix the stratified fluid near the ridge; the circulation set up by the collapse of the mixed fluid is determined. In the second study, ray theory is used to analyze lee waves generated behind a low ridge being slowly towed periodically through a stratified fluid. Author (GRA)

N73-11370# Plessy Environmental Systems, San Diego, Calif.
STUDY TO DETERMINE THE IMPLICATIONS OF REMOTE SENSING DATA ON US FISHING TECHNOLOGY: TROPICAL TUNA AND ALASKA SALMON Final Report, 1971-1972
Robert P. Brown, Edward H. Shenton, Gordon Broadhead, Frank Alverson, and Charles Peckham Jun. 1972 195 p refs Prepared in cooperation with Living Marine Resources, Inc., San Diego, Calif.
(Contract N62306-71-C-0012)
(AD-745774) Avail: NTIS CSCL 05/3

A study was conducted during 1971 and 1972 to determine ways in which remotely sensed data from spacecraft and aircraft could be used to assist fishery technology in tropical tuna and Alaska salmon fisheries. The project assessed the operational characteristics of each of these fisheries including the history, biology, vessels and gear, search and catch methods, economics, and research and regulatory aspects. A similar assessment was made of the state-of-the-art of remote sensors with application to fishery oceanography. A series of field verification visits were made to each fishery and for remote sensing. Author (GRA)

N73-11371# Institute for Defense Analyses, Arlington, Va. Jason Div.
LAGRANGIAN THEORY OF INTERNAL WAVE INTERACTION
Marshall Rosenbluth Dec. 1971 15 p refs
(Contract DAHC15-67-C-0011)
(AD-746149; P-838; IDA/HQ-72-14313) Avail: NTIS CSCL 08/3

A Lagrangian theory of internal wave interaction is developed. The motion considered is that of a uniformly rotating ocean perturbed about a stationary equilibrium state. The Lagrangian (with incompressibility as a constraint) is expanded in powers of the displacement, and the equation of motion for the wave amplitudes obtained. An order of magnitude estimate is then made for the wave-wave coupling coefficient and energy transfer rate. Author (GRA)

N73-11372# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. Final Report, 1962 - 1971
RADAR METEOR TRAIL TASK
Arnold J. Barnes, Jr. 22 Mar. 1972 47 p refs
(AF Proj. 8628)
(AD-745959; AFCRL-72-0190; AFCRL-ERP-397) Avail: NTIS CSCL 04/1

An advanced, inexpensive, transportable radar meteor trail set was developed and was recommended as an international standard by IUCSTP at the Moscow 1971 COSPAR meeting. The interferometer height-measuring technique, tested with the CRLH 001 Beacon in satellite OV1-17, was also recommended because of ground calibration capability and achieved accuracy. Computer programs for data reduction and advanced analysis were used to reduce and study wind and density data from AFCRL, Eglin AFB, Stanford University and the University of New Hampshire. Results were compared with other investigators' findings. Author (GRA)

N73-11373# Naval Ordnance Lab., White Oak, Md.
ACOUSTIC MEASUREMENTS IN THE WEST GREENLAND SEA
David L. Bradley and Gabriel M. Colvin 12 Jun. 1972 17 p refs
(AD-746839; NOLTR-72-134) Avail: NTIS CSCL 20/1

Acoustic ambient noise, transmission loss and reverberation measurements were made in the West Greenland Sea at the edge of the permanent polar ice pack during the fall of 1971. The data were collected with the assistance of the U.S. Coast Guard, while deployed on one of its oceanographic data collection cruises. The sound sources for transmission loss and reverberation measurements were standard U.S. Navy explosive sound signals. The receiving system consisted of calibrated sonobuoys which were monitored both from helicopters and the Coast Guard icebreaker. Author (GRA)

N73-11374# Wyoming Univ., Laramie. Dept. of Physics and Astronomy.
MEASUREMENT OF SUBMICRON PARTICULATE MATTER IN THE ARCTIC STRATOSPHERE Final Report, 25 Mar. 1971 - 24 Mar. 1972
David J. Hofmann, James M. Rosen, and Norman T. Kjome Jul. 1972 19 p refs
(Contract N00014-70-A-0266-0003)
(AD-747256) Avail: NTIS CSCL 04/1

Balloon measurements of the north and south polar stratospheric aerosol and ozone content were determined. Indicate that concentrations of these constituents in either stratosphere do not differ substantially from those observed previously at mid-latitudes. Laminar transport, thought to be a mid-latitude phenomenon, is suggested by the data near the North Pole during the Arctic winter. Author (GRA)

N73-11375# Teledyne Geotechnical, Alexandria, Va.
SAAC (LASA) EQUIPMENT AND SOFTWARE PERFORMANCE
E. B. McCoy 16 Jun. 1972 61 p refs
(Contract F33657-71-C-0510; ARPA Order 1620)
(AD-745874; SAAC-TR-7) Avail: NTIS CSCL 17/10

The performance of the equipment and software of the SAAC (LASA) system is presented in the report. The system operates in two parts. The Detection Processor performs data acquisition and signal detection. The Event Processor selects detections to process as events, refines locations and publishes an earthquake bulletin. The performance of both processors was high. The Detection Processor operated 97% of all available time throughout the second half of the year. The Event Processor report coverage was virtually the same as DP recording coverage throughout most of the year. Author (GRA)

N73-11376# Defense Mapping Agency Aerospace Center, St. Louis, Mo.
AUTOMATIC CARTOGRAPHY ABROAD: STATUS AND PROBLEMS
K. A. Salishchev Jul. 1972 19 p Transl. into ENGLISH from Vestn. Mosk. Univ. Ser. 5: Geograf. (Moscow), no. 1, 1972 p 12-20
(AD-746019; DMAAC-TC-1845) Avail: NTIS CSCL 08/2

The paper contains a review and analysis of the current status and prospects of mapping automation, based on information from the Automation Commission of the International Cartographic Association which met in Paris (June, 1971) under the auspices of UNESCO. One of the most significant conclusions consists of a re-assessment of the role and importance of the cartographer in automatic map compilation. Compilation of complex maps requires: (a) participation of the cartographer in the final adjustment and coordination of the original maps being automatically compiled and, consequently, (b) inclusion of special devices into the automated cartographic systems which ensure a joint survey of the data being mapped, in their automatic compilation and drawing processes, and enable the cartographer to make additions, deletions, or modifications which are simultaneously automatically recorded. Author (GRA)

N73-11377# GCA Corp., Bedford, Mass. Technology Div.
LAMBDA PROTOTYPE DEVELOPMENT AND TESTING Final Report, 23 Apr. 1970 - 31 May 1971
Henry A. Miranda, Jr. Aug. 1972 57 p refs
(Contract DASA01-70-C-0125; DNA Proj. NWET-K11BAXH)
(AD-747335; GCA-TR-72-5-G; DNA-2897F) Avail: NTIS CSCL 04/1

Continued development work performed on the LaMBDA

device, a high-power pulsed laser tuned to probe the upper atmosphere for individual atomic species concentration, is described. Recent accomplishments described include: Incorporation of a high-power yellow laser, and routine measurement of the natural sodium layer at the 90-100 km level. Development of prototype green and blue lasers. Achievement of 10,000-pulse lamp lifetimes. Use of this newly demonstrated capability to collect data of importance to the ABM and DNA communities, which can be obtained in no other manner, is discussed briefly.
Author (GRA)

N73-11378# Naval Research Lab., Washington, D.C.
LOW ENERGY ELECTRON IMPACT RATE COEFFICIENTS FOR SOME ATMOSPHERIC SPECIES Interim Report
A. W. Ali and A. D. Anderson 27 Jun. 1972 50 p refs
(AD-747244; NRL-7432) Avail: NTIS CSCL 04/1

Low-energy electron impact excitation and ionization rate coefficients, relevant to ionospheric species, are calculated using measured or calculated cross sections. Author (GRA)

N73-11379# Woods Hole Oceanographic Institution, Mass.
GRAVITY OBSERVATIONS 09.0 DEG E TO 37.9 DEG W ALONG THE EQUATOR
J. P. Dean and C. B. McCullough Jul. 1972 35 p
(Contract N00014-66-C-0241; NR Proj. 083-004)
(AD-746465; WHOI-72-56) Avail: NTIS CSCL 08/5

The report presents free air gravity values and computed free air anomalies obtained on an equatorial traverse from 09 degrees 00 minutes E to 37 degrees 56 minutes W. It is the second of a series of reports presenting the gravity data to be used in deriving a ground truth calibration grid for comparison with topographical details of the world oceans obtained by a radar altimeter in an earth satellite scheduled to fly in 1974.
Author (GRA)

N73-11380# Defense Mapping Agency Aerospace Center, St. Louis, Mo. Technical Translation Branch.
A PROGRAM FOR COMPUTING THE GRAVIMETRIC DEFLECTIONS OF THE VERTICAL IN THE CENTRAL ZONE
V. I. Aronov, V. M. Gordin, N. E. Belyaikov, and A. L. Shirginova Jul. 1972 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Geod. Aerofotos. (Moscow), no. 4, 1971 p 41-45
(AD-747136; DMAAC-TC-1868) Avail: NTIS CSCL 08/5

The theoretical basis of the method discussed in this paper for a program for computing the gravimetric deflections of the vertical in the central zone is given in V. I. Aronov's studies. Here it is shown that the accuracy of computations is close to the optimum accuracy both in the case of a precise assignment of the delta G values at the observation points and in the case where the initial data contain random errors of measurements and non-representative field characteristics. The practical realization of the method was carried out in the system of the :Reduction-Otves: programs for a BESM-4 type computer.
Author (GRA)

N73-11381# Illinois Univ., Urbana. Dept. of Civil Engineering.
WAVE PROPAGATION IN A HALF SPACE DUE TO AN INTERIOR POINT LOAD PARALLEL TO THE SURFACE
J. J. Johnson and A. R. Robinson Jul. 1972 190 p refs
(Contract N00014-67-A-0305-0010; NR Proj. 064-183)
(AD-747306; UILU-ENG-72-2010; Struct-Res-Ser-388) Avail: NTIS CSCL 13/13

The state of stress in a body subjected to dynamic loads is the result of the propagation of stress waves generated by the disturbances. In an isotropic elastic body, both dilatational and distortional waves can exist. The principal difficulty that arises in the solution of wave propagation problems in bounded elastic media is the interaction of these dilatational and distortional waves at a bounding surface. The simplest cases in which such interaction occurs involve a half space, where there is only one plane bounding surface. The object of this study was to develop the method of rotational superposition for the solution of a certain class of three-dimensional wave propagation problems. This method, when coupled with the method of self-similar potentials, is shown to be an effective alternative to the classical Laplace transform and harmonic wave techniques.
Author (GRA)

N73-11382# Teledyne Geotechnical, Garland, Tex.
LONG RANGE SEISMIC MEASUREMENTS Final Report, Jan. 1970 - Oct. 1971
23 May 1972 216 p refs
(Contract F33615-70-C-0646; ARPA Order 624)
(AD-746666; TR-71-24) Avail: NTIS CSCL 17/10

The progress of the Long-Range Seismic Measurements (LRSM) Program during the period 1 January 1970 through 31 October 1971 is described. At the beginning of the report period, there were seven mobile observatories and eleven portable seismograph systems in the LRSM program. These seismograph systems participated in related programs and experiments such as MIRACLE PLAY - HUMID WATER, HANDLEY, and CANNIKIN. Six portable strain systems were operated at the Nevada Test Site. Several special studies were conducted - deep hole, long-period instrumentation evaluation; long-period noise study at Fairbanks, Alaska; atmospherically-generated seismic noise study at Grand Saline, Texas, and Wills Point, Texas.
Author (GRA)

N73-11383# Wentworth Inst., Boston, Mass.
PAYLOAD INTEGRATION FOR FALLING SPHERE INSTRUMENTATION Final Report, 15 May 1969 - 14 May 1972
Martin J. Davin 14 Jun. 1972 20 p
(Contract F19628-69-C-0255; AF Proj. 5710)
(AD-747037; AFCRL-72-0385) Avail: NTIS CSCL 04/1

The work carried on under this contract was directed towards participation in the Aeronomy Laboratory's program devoted to the measurement of upper atmosphere density, temperature, and pressure through the medium of the free-falling sphere technique. Included therein were payload integration and field support for experimental rocket systems used to determine upper atmosphere density in the altitude region above 100 km, as well as the fabrication of the basic rocket payload hardware, such as special nose cones, upper and lower sphere holders, sphere ejection devices, radar transponder assemblies, and the transitions sections for mating the rocket and payload components. Also included were the improvement of the ground-based telemetry apparatus for the experimental payload, the investigation of devices for increasing the range and reliability of high altitude density measurements, participation in the launching of the rocket-borne experiments at sites designated by the Air Force Cambridge Research Laboratories, and the processing of flight data. GRA

N73-11586* Atmospheric Environment Service, Toronto (Ontario).
A REVIEW OF SOME ASPECTS OF INFERRING THE OZONE PROFILE BY INVERSION OF ULTRAVIOLET RADIANCE MEASUREMENTS
Carlton L. Mateer *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 24 p (For availability see N73-11585 02-19)
CSCL 03B

N73-11587* Oxford Univ. (England). Clarendon Lab.
STATISTICAL RETRIEVAL TECHNIQUES FOR SOUNDING THE METEOROLOGICAL STRUCTURE OF THE ATMOSPHERE
C. D. Rodgers *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11588* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A REVIEW OF NONSTATISTICAL TECHNIQUES FOR THE ESTIMATION OF VERTICAL ATMOSPHERIC STRUCTURE FROM REMOTE INFRARED MEASUREMENTS
B. J. Conrath and I. Revah *In its* Math. of Profile Inversion Aug. 1972 14 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11589* National Environmental Satellite Service, Suitland, Md.
STATISTICAL VERSUS NONSTATISTICAL TEMPERATURE INVERSION METHODS
W. L. Smith and H. E. Fleming *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 7 p (For availability

see N73-11585 02-19)
CSCL 04A

N73-11590* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RECENT DEVELOPMENTS IN THE INVERSION BY THE METHOD OF RELAXATION
Moustafa T. Chahine *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
(Contract NAS7-100)
CSCL 04A

N73-11592* Weapons Research Establishment, Salisbury (Australia).
ACOUSTIC RADAR SOUNDING OF THE LOWER ATMOSPHERE
L. G. McAllister *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11593* Lincoln Lab., Mass. Inst. of Tech., Lexington.
ATMOSPHERIC RADAR SOUNDING
R. K. Crane *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
(Contract NAS5-21544)
CSCL 04A

N73-11594* Naval Electronics Lab. Center, San Diego, Calif. Propagation Technology Div.
FINE STRUCTURE OF THE LOWER ATMOSPHERE AS SEEN BY HIGH RESOLUTION RADAR
J. H. Richter, E. E. Gossard, and D. R. Jensen *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 8 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11597* Polytechnic Inst. of Brooklyn, N.Y.
ERRORS INCURRED IN PROFILE RECONSTRUCTION AND METHODS FOR INCREASING INVERSION ACCURACIES FOR OCCULTATION TYPE MEASUREMENTS
S. H. Gross and J. A. Pirraglia *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 15 p (For availability see N73-11585 02-19)
(Grant NGR-33-006-047)
CSCL 03B

N73-11601* Stanford Univ., Calif.
AN OCCULTATION SATELLITE SYSTEM FOR DETERMINING PRESSURE LEVELS IN THE ATMOSPHERE
Steven G. Ungar and Bruce B. Lusignan *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 13 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11602* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE P PRIME(f) TO N(h) INVERSION PROBLEM IN IONOSPHERIC SOUNDINGS
John E. Jackson *In its* Math. of Profile Inversion Aug. 1972 13 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11603* Communications Research Centre, Ottawa (Ontario).
THE CALCULATION OF ELECTRON DENSITY PROFILES FROM TOPSIDE IONOGRAMS: METHOD AND APPLICATIONS
G. E. K. Lockwood *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11604* Informatics, Inc., Palo Alto, Calif.
NUMERICAL METHODS FOR REDUCTION OF TOPSIDE IONOGRAMS
L. McCulley *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11605* National Oceanic and Atmospheric Administration, Boulder, Colo.
THE MATHEMATICAL-PHYSICAL PROBLEM OF P PRIME(f) TO N(h) INVERSION FOR ANISOTROPIC MEDIA
A. K. Paul *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 13 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11606* National Oceanic and Atmospheric Administration, Boulder, Colo.
AUTOMATIC N(h,t) PROFILES OF THE IONOSPHERE WITH A DIGITAL IONOSONDE
J. W. Wright, A. R. Laird, E. J. Violette, D. McKinnis, and D. Obitts *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11607* Stanford Research Inst., Menlo Park, Calif.
IONOSPHERIC PROFILE INVERSION USING OBLIQUE-INCIDENCE IONOGRAMS
D. L. Nielson and T. M. Watt *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 12 p (For availability see N73-11585 02-19)
CSCL 04A

N73-11626* Naval Electronics Lab. Center, San Diego, Calif.
THE INVERSION OF VLF-LF SOUNDER DATA TO OBTAIN D-REGION ELECTRON-DENSITY DISTRIBUTIONS
C. H. Shellman *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 7 p refs (For availability see N73-11585 02-19)
CSCL 04A

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N73-11384 National Lending Library for Science and Technology, Boston Spa (England).
APPARATUS AND METHOD FOR MEASURING ADHESION FORCE
R. Niewind and H. Moehle 27 Jul. 1972 14 p refs Transl. into ENGLISH from Allgem. Papier-Rundsch. (Heusenstamm), no. 19, 1965 p 1240-1246
(NLL-Trans-2863-(9022.81)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A description is given of an apparatus for measuring adhesive force; all the basic operations of this apparatus are automatic. It is suitable for testing gummed papers and glues, and for quality control and basic research. Some of the essential factors involved in the testing of adhesives are discussed in relation to the results obtained from the first series of measurements.
Author

N73-11385 National Oceanographic Instrumentation Center, Washington, D.C.
LABORATORY EVALUATION OF DISSOLVED OXYGEN ANALYZERS
Sep. 1972 11 p
(RN-1007) Avail: Chief, Documentation Division, Code C634, NOAA/NOIC, Department of Commerce, Rockville, Md. 20852

A comprehensive testing program, designed to obtain data for performance comparison, on MINOS DOM, Model 735, Ionics Model 1131, and 11A portable water dissolved oxygen analyzers is presented. Tests cover power fluctuation effects, flow sensitivity, response time, temperature accuracy, error and repeatability,

stability, environmental effects, and pressure effects. Performance evaluation results are given in tabular form. E.H.W.

N73-11386*# Perkin-Elmer Corp., Norwalk, Conn.
SPACE SHUTTLE IMPACT ON LARGE TELESCOPE EXPERIMENT PROGRAM (LTEP)
16 Apr. 1970 31 p
(Contract NAS8-21497)
(NASA-CR-123923) Avail: NTIS HC $3.75 CSCL 20F

The agenda, experiments and flight program objectives for the LTEP are presented. F.O.S.

N73-11387# Communications Research Centre, Ottawa (Ontario).
MICROWAVE RADIOMETRY FOR SURVEILLANCE FROM SPACECRAFT AND AIRCRAFT
A. W. Adey Feb. 1972 30 p refs
(CRC-1231) Avail: NTIS HC $3.50

The status of current airborne and satellite remote sensing programs based on microwave radiometers is reviewed. Details of instrumentation capabilities and limitations are given and research areas and problems where these devices have application are outlined. A bibliography is included. Author

N73-11388# Aircraft Research Association, Ltd., Bedford (England).
A VISUAL DISPLAY DEVICE FOR DATA LOGGERS
A. Pendleton Sep. 1972 11 p
(ARA-28) Avail: NTIS HC $3.00

A display device specifically designed for the visualization of pressure coefficients obtained from models in a wind tunnel is described. The device may find applications in other fields. Author

N73-11389# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
PHASE-SWITCHED FM-CW RADIO ALTIMETER
Kohti Itoh and Moriyuki Mizumachi Jul. 1972 14 p refs
(ISAS-484-Vol-37-10) Avail: NTIS HC $3.00

The radio altimeter with frequency-modulated signal and frequency counting type of processing was investigated from the view point of airborne sensor at landing. The phase switching of transmitting signal is proposed to reduce the step error of processing. The phase switching technique was applied to the altimeter with the frequencies: 4000 MHz of carrier and 100 MHz of band width. Some results of experiment are described with theoretical analysis. Author

N73-11390# Research Inst. of National Defence, Stockholm (Sweden).
EQUIPMENT FOR TESTING SANDWICH ELEMENTS [UTRUSTNING FOER HAELLFASTHETSPROVNING AV SANDWICHELEMENT]
F. Larsson Sep. 1971 41 p refs In SWEDISH
(FOA-4-C-4472-E6) Avail: NTIS HC $4.25

The equipment consists of arrangements for tensile tests, shearing tests, bending tests, and hydrostatic pressure tests of sandwich elements. Typical data are tabulated. Author

N73-11391# Research Inst. of National Defence, Stockholm (Sweden).
RECONNAISSANCE BY RADIOMETRIC METHODS
A. Rundkwist Jul. 1971 13 p In SWEDISH, ENGLISH summary
(FOA-3-C-3675-E1) Avail: NTIS HC $3.00

A summary of the basic properties of radiometric reconnaissance is presented together with a general description of radiometer principles. Transl. by G.G.

N73-11392# Research Inst. of National Defence, Stockholm (Sweden). Dept. 3.
INTENSITY MODULATION OF PHOTOGRAPHIC FILM BY MEANS OF A CATHODE-RAY TUBE
Hans Lok Jun. 1971 31 p ref In SWEDISH
(FOA-3-C-3677-62) Avail: NTIS HC $3.75

Results are reviewed from examinations of recordings of electrical signals on film by means of two different oscilloscopes, one a standard Tektronix 585 oscilloscope and the other constructed by FOA section 265 as a high resolution oscilloscope. The object was mainly to investigate whether the FOA 265 oscilloscope was suitable for recording SLAR signals from a fully coherent SLAR. As a result, the main emphasis of the experiments was on the transfer of a linear, frequency-modulated electrical signal corresponding to the signal from an SLAR. Author

N73-11393# Research Inst. of National Defence, Stockholm (Sweden). Dept. 3.
BISTATIC TRAGET AREA FOR CERTAIN SIMPLE TARGETS
Erik Tedstedt Aug. 1971 18 p In SWEDISH
(FOA-3-C-3676-E1) Avail: NTIS HC $3.00

The bistatic target areas of three simple targets were measured for seven bistatic angles. The measurements are presented in diagrammatic form. Author

N73-11394*# Perkin-Elmer Corp., Pomona, Calif. Aerospace Div.
OPERATIONS AND MAINTENANCE MANUAL, ATMOSPHERIC CONTAMINANT SENSOR. ADDENDUM 1: CARBON MONOXIDE MONITOR MODEL 204
Mar. 1972 23 p Revised
(Contract NAS9-12066)
(NASA-CR-128602; SPO-30249-Rev-B-Add-1) Avail: NTIS HC $3.25 CSCL 14B

An instrument for monitoring the carbon monoxide content of the ambient atmosphere is described. The subjects discussed are: (1) theory of operation, (2) system features, (3) controls and monitors, (4) operational procedures, and (5) maintenance and troubleshooting. Block drawings and circuit diagrams are included to clarify the text. Author

N73-11395*# Perkin-Elmer Corp., Pomona, Calif. Aerospace Div.
ATMOSPHERIC CONTAMINANT SENSOR. BOOK 3 OF 3: ADDENDUM
Richard Burke and J. H. Stuart Sep. 1972 45 p
(Contract NAS9-12066)
(NASA-CR-128604; SPO-30249-BK-3) Avail: NTIS HC $4.25 CSCL 14B

The modification of the Atmospheric Contaminant Sensor (ACS) to produce a carbon dioxide measuring capability is discussed. The modified instrument is described and the instructions for its operation and maintenance are included. Schematic diagrams and circuit drawings are included to clarify the text. Author

N73-11396*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT AND TESTING OF THE ULTRAVIOLET SPECTROMETER FOR THE MARINER MARS 1971 SPACECRAFT
J. W. Farrar 15 Oct. 1972 18 p refs
(Contract NAS7-100)
(NASA-CR-128493; JPL-TM-33-569) Avail: NTIS HC $3.00 CSCL 14B

The Mariner Mars 1971 ultraviolet spectrometer is an Ebert-Fastie type of the same basic design as the Mariner Mars 1969 instrument. Light enters the instrument and is split into component wavelengths by a scanning reflection diffraction grating. Two monochrometer exit slits allow the use of two independent photomultiplier tube sensors. Channel 1 has a spectral range of 1100 to 1692 A with a fixed gain, while Channel 2 has a spectral range of 1450 to 3528 A with an automatic step gain control, providing a dynamic range over the expected atmosphere and surface brightness of Mars. The scientific objectives, basic operation, design, testing, and calibration for the Mariner Mars 1971 ultraviolet spectrometer are described. The design discussion includes those modifications that were necessary to extend the lifetime of the instrument in order to accomplish the Mariner Mars 1971 mission objectives. Author

N73-11397*# National Aeronautics and Space Administration, Washington, D.C.
GRATING-TYPE INFRARED FOURIER SPECTROMETER
M. N. Markov, V. I. Vedernikov, V. V. Ivanov, A. V. Kartashev, and V. S. Petrov Jun. 1972 36 p refs Transl. into ENGLISH of Preprint No. 189, "Bortovoy, Infrakrasnyy Furye-Spektrmetr" Moscow, Akad. Nauk SSSR. Fiz. Inst. Optich. Lab., 1969 41 p

(NASA-TT-F-14425) Avail: NTIS HC $4.00 CSCL 14B
The work is reported for producing a small-size Fourier spectrometer for measuring the absolute spectral intensity of the earth and other planetary emissions, in the wavelengths from 10 to 40 microns from aircraft, balloons, and satellites. The grating-type infrared Fourier spectrometer is described as consisting of a Michelson interferometer, an electronic low inertia noncooled bolometer with a transitorized amplifier, and a system of automatic control, and a mechanical-pitch driving gear of a mobile interferometer mirror. The recording and processing of interferograms are described. F.O.S.

N73-11398*# Kanner (Leo) Associates, Redwood City, Calif.
DETERMINATION OF TIME CONSTANT OF LOW-INERTIA RESISTANCE THERMOMETERS BY THE ALTERNATING CURRENT METHOD
I. P. Pelepeychenko Washington NASA Sep. 1972 8 p refs Transl. into ENGLISH from Priborostroenie (Moscow), v. 13, no. 5, 1970 p 95-99
(NASA-TT-F-14494) Avail: NTIS HC $3.00 CSCL 14B
A method is analyzed for determining the time constant of a resistance thermometer by double heating with direct and alternating currents. Author

N73-11399*# CBS Labs., Stamford, Conn.
ELECTROSTATIC CAMERA SYSTEM FUNCTIONAL DESIGN STUDY Final Report
Robert A. Botticelli, Frank J. Cook, and Robert F. Moore 25 Feb. 1972 54 p Prepared for JPL
(Contracts NAS7-100; JPL-953301)
(NASA-CR-129093) Avail: NTIS HC $4.75 CSCL 14E
A functional design study for an electrostatic camera system for application to planetary missions is presented. The electrostatic camera can produce and store a large number of pictures and provide for transmission of the stored information at arbitrary times after exposure. Preliminary configuration drawings and circuit diagrams for the system are illustrated. The camera system's size, weight, power consumption, and performance are characterized. Tradeoffs between system weight, power, and storage capacity are identified. Author

N73-11400*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DISCRETE CONTROL OF LINEAR DISTRIBUTED SYSTEMS WITH APPLICATION TO THE DEFORMABLE PRIMARY MIRROR OF A LARGE ORBITING TELESCOPE Ph.D. Thesis - Rhode Island Univ.
Jeremiah F. Creedon 1970 112 p refs
(NASA-TM-X-68855) Avail: NTIS HC $7.75 CSCL 14B
The results are presented of a detailed study of the discrete control of linear distributed systems with specific application to the design of a practical controller for a plant representative of a telescope primary mirror for an orbiting astronomical observatory. The problem of controlling the distributed plant is treated by employing modal techniques to represent variations in the optical figure. Distortion of the mirror surface, which arises primarily from thermal gradients, is countered by actuators working against a backing structure to apply a corrective force distribution to the controlled surface. Each displacement actuator is in series with a spring attached to the mirror by means of a pad intentionally introduced to restrict the excitation of high-order modes. Control is exerted over a finite number of the most significant modes. Author

N73-11401*# Mechanical Technology, Inc., Latham, N.Y.
HIGH PRESSURE PULSED CAPILLARY VISCOMETRY
R. L. Smith, Jed A. Walowit, and C. H. T. Pan 17 Aug. 1972 61 p refs
(Contract NAS3-14419)
(NASA-CR-120982; MTI-72TR33) Avail: NTIS HC $5.25 CSCL 14B
An analytical and test program was conducted in order to establish the feasibility of a multichamber pulsed-capillary viscometer. The initial design incorporated a piston, ram, and seals which produced measured pulses up to 30,000 psi in the closed chamber system. Pressure pulses from one to ten milliseconds were investigated in a system volume of 1 cu in. Four test fluids: a MIL-L-7808, a 5P4E polyphenyl ether, a MIL-L-23699A, and a synthetic hydrocarbon were examined in the test pressure assembly. The pressure-viscosity coefficient and viscosity delay time were determined for the MIL-L-7808 lubricant tested. Author

N73-11402*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PISTON MANOMETER AS AN ABSOLUTE STANDARD FOR VACUUM-GAGE CALIBRATION IN THE RANGE 2 TO 500 MILLITORR
Isidore Warshawsky Washington Nov. 1972 19 p refs
(NASA-TN-D-7059; E-7037) Avail: NTIS HC $3.00 CSCL 14B
A thin disk is suspended, with very small annular clearance, in a cylindrical opening in the base plate of a calibration chamber. A continuous flow of calibration gas passes through the chamber and annular opening to a downstream high vacuum pump. The ratio of pressures on the two faces of the disk is very large, so that the upstream pressure is substantially equal to net force on the disk divided by disk area. This force is measured with a dynamometer that is calibrated in place with dead weights. A probable error of + or - (0.2 millitorr plus 0.2 percent) is attainable when downstream pressure is known to 10 percent. Author

N73-11403*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
STAR SENSOR/MAPPER WITH A SELF DEPLOYABLE, HIGH-ATTENUATION LIGHT SHADE FOR SAS-B
Fred W. Schenkel and A. Finkel Jul. 1972 120 p refs Sponsored in part by NASA
(Contract N00017-72-C-4401)
(NASA-CR-129192; APL/JHU-CP-017) Avail: NTIS HC $8.00 CSCL 20F
A star sensor/mapper to determine positional data for the small astronomy satellites was tested to detect stars of plus 4 visual magnitude. It utilizes two information channels with memory so that it can be used with a low-data-rate telemetry system. One channel yields star amplitude information; the other yields the time of star occurrence as the star passes across an N-slit reticle/photomultiplier detector system. Some of the features of the star sensor/mapper are its low weight of 6.5 pounds, low power consumption of 0.4 watt, bandwidth switching to match the satellite spin rate, optical equalization of sensitivity over the 5-by-10 deg field of view, and self-deployable sunshade. The attitude determination accuracy is 3 arc minutes. This is determined by such parameters as the reticle configuration, optical train, and telemetry readout. The optical and electronic design of the star sensor/mapper, its expansion capabilities, and its features are discussed. Author

N73-11404*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
STAR SCANNER Patent Application
Richard L. Gutshall (Ball Brothers Res. Corp.), Randall T. McConaughey (Ball Brothers Res. Corp.), and Frank A. Volpe, inventors (to NASA) Filed 29 Sep. 1972 21 p
(NASA-Case-GSC-11569-1; US-Patent-Appl-SN-293725) Avail: NTIS HC $3.25 CSCL 20F
A star scanner on a spin-stabilized spacecraft includes a reticle with a pair of slits having different separations as a function of the spacecraft vertical plane and forming a V-slit. The time between a star image crossing one of the slits relative to a reference telemetry time provides an indication of azimuth angle. The time between the image crossing the two slits provides an indication of elevation angle of the star. If a star cluster is detected such that two stars pass the slits in less time than normally required for a single star to cross the two slits, an indication of the cluster occurrence is derived. Means are provided to prevent effective detection of large celestial bodies, such as the sun or moon. NASA

N73-11405*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CONDUCTIVE ELASTOMERIC EXTENSOMETER Patent Application
Raymond L. Gause and C. G. Glenn, inventors (to NASA) Filed 7 Nov. 1972 9 p
(NASA-Case-MFS-21049-1; US-Patent-Appl-SN-304430) Avail:

NTIS HC $3.00 CSCL 14B

An extensometer for measuring surface area changes of the human body caused by expansion and contraction of the body is described. The instrument is composed of a relatively thin and wide strain responsive conductive elastomeric band adapted for application to a part of the body, such as around a limb or the trunk of the body. The elastomeric band is incorporated as a resistor in a balanced bridge circuit. Expansion or contraction of the portion of the body on which the elastomeric band is applied causes a change in the resistance of the band and a resultant imbalance of the bridge circuit generating an output that is fed into an amplifier. The output of the amplifier in volts is suitable for providing the desired reading through a recorder, oscilloscope, or voltmeter. NASA

N73-11406*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ATTITUDE SENSOR Patent Application

Arthur L. Newcomb, Jr. and Aubrey G. Price, inventors (to NASA) Filed 14 Sep. 1972 10 p

(NASA-Case-LAR-10586-1; US-Patent-Appl-SN-289049) Avail: NTIS HC $3.00 CSCL 22B

The invention consists essentially of two light sensors on a spacecraft that are mounted beneath a baffle which divides the light from a light source such as the sun or a star. The divided light reflects off of two reflective surfaces onto the two light sensors. When the spacecraft assumes its normal attitude the baffle divides the light from the light source into two equal parts causing the two light sensors to produce equal outputs. An electrical circuit containing the two sensors produces a zero voltage output when the outputs of the two light sensors are equal thereby indicating that the spacecraft is in its normal attitude relative to the light source. While the spacecraft is not in its normal attitude relative to the light source the two light sensors produce unequal outputs causing the electrical circuit to produce an output voltage. The amplitude and polarity of this output voltage are indicative of the attitude of the spacecraft and can be applied to the controls of the spacecraft to return it to its normal attitude. NASA

N73-11407# Advisory Group for Aerospace Research and Development, Paris (France).

V/STOL DISPLAYS FOR APPROACH AND LANDING

Jul. 1972 50 p refs

(AGARD-R-594) Avail: NTIS HC $4.50

The design and development of display systems were studied for developing all-weather operational capability in terminal areas for V/STOL aircraft. Aspects of the study discussed include: operational factors and ground environment, vehicle configuration, terminal area flight profiles, pilot factors, tradeoffs, guidance and control, and human engineering. The conclusions of the study are summarized, and the recommendations for future research and development are included. F.O.S.

N73-11408# National Bureau of Standards, Washington, D.C. Heat Div.

OPTICAL RADIATION MEASUREMENTS: PHOTOMETRIC CALIBRATION PROCEDURES

Velma I. Burns and Donald A. McSparron Nov. 1972 35 p refs

(NBS-TN-594-3) Avail: SOD $0.60 as C13.46:594-3

Calibrations of luminous intensity, luminous flux, and color temperature of incandescent lamps are discussed. The procedures, equipment, and techniques used to perform the calibrations are described. Details of the uncertainty information available, including estimates and procedures for determining uncertainties of reported values, are also presented. Author

N73-11409*# Amerind Publishing Co. Pvt. Ltd., New Delhi (India).

DECIPHERING OF GROUNDWATER FROM AERIAL PHOTOGRAPHS

K. E. Nefedov and T. A. Popova 1972 201 p refs Transl. into ENGLISH of the publ. "Deshifri rovanie gruntovykh vod po aerofotosnimkam" Leningrad, Gidrometeorol., 1969 Sponsored by NASA and NSF

(NASA-TT-F-681; TT-71-58005) Avail: NTIS HC $3.00 CSCL 14E

The use of aerial photographs in groundwater studies is discussed. The principles of groundwater photointerpretation, aerial photo sampling, and extrapolation of aerial photo indexes are described. The technique is given for the medium-scale mapping of groundwater in areas of deficient precipitation. Various landscape elements and morphological units are considered in terms of the estimation of groundwater conditions. Author

N73-11410# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Electron Physics.

AN ION FLUX PROBE FOR A LOW PRESSURE DISCHARGE PLASMA

S. Torven and M. Babic Sep. 1972 11 p refs

(TRITA-EPP-72-20) Avail: NTIS HC $3.00

Fine apertures drilled in a thin metal plate were inserted in the confining glass wall connecting the discharge column with an external volume containing a pressure gage. Atom and ion fluxes were derived from pressure measurements made at different electric potentials of the metal plate. The results are compared with measurements by Langmuir probe characteristics. Author (ESRO)

N73-11411# Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).

EVACUATION AND DEGASSING OF A VACUUM ULTRA-VIOLET SOUNDING ROCKET PHOTOMETER [EVAKUIEREN UND AUSGASEN EINES VUV-RAKETENPHOTOMETERS]

Helmut Hessberg Jul. 1972 43 p refs In GERMAN; ENGLISH summary

(MPI-PAE/Extraterr-68) Avail: NTIS HC $4.25

A rough formula is derived for correlation of the vacuum inside a vacuum ultraviolet photometer and the area of degassing holes, for sounding rocket experiments. It is shown that for experiments which need a certain minimum vacuum, the maximum residual pressure at altitudes over 100 km after a certain time in the interior of the payload can be determined from the approximation formula: $p(i).a = 1/13.Q(t)$, in which p(i) is internal pressure (in Torr), a the area of necessary holes in the rocket casing (in sq cm), and Q(t) the estimated degassing rate (in Torr.1/sec) in the inner volume. Author (ESRO)

N73-11412# Defence Research Information Centre, Orpington (England).

THE ACQUISITION OF A COLOUR POSITIVE TV IMAGE FROM COLOUR NEGATIVE CINEFILM

S. V. Novakovskii et al Sep. 1972 16 p refs Transl. into ENGLISH from Tekhn. Kino i Televideniya (Moscow), v. 2, 1972 p 9-14

(DRIC-Trans-2835; BR-30206) Avail: NTIS HC $3.00

The principle of the production of a positive image from negative cinefilm is described and results of experimental research into this method are given. The procedure involves the use of TV equipment such that the film corresponding to the negative is mounted making possible the reception on a picture tube of positive black/white and color images directly from the negative film. Author (ESRO)

N73-11413# Defence Research Information Centre, Orpington (England).

PULSE CHARACTERISTIC CURVES PF VIDICONS

I. A. Rumyantsev et al Sep. 1972 9 p refs Transl. into ENGLISH from Tekhn. Kino i Televideniya (Moscow), v. 4, 1972 p 64-66

(DRIC-Trans-2875; BR30255) Avail: NTIS HC $3.00

The development of small screen TV systems using pulse readout and the choice of a system of electrical signal recording on a vidicon screen with memory, requires a knowledge of the value of the pulse currents of the vidicon beam. Data concerning the value of the vidicon beam current, pulse modulation characteristics, are measured and recorded as curves for various vidicons and with different constructions of cathode beams. Author (ESRO)

N73-11414# Kansas Univ./Center for Research, Inc., Lawrence. Remote Sensing Lab.

TEXTURE TONE STUDY (QUANTIZING ON THE IDECS/PDP) Interim Technical Report, 1 Nov. 1971 - 1 Mar. 1972

Its'hak Dinstein Mar. 1972 34 p ref

(Contract DAAK02-70-C-0388)
(AD-743526; CRINC-TR-182-3; ITR-3; ETL-CR-72-3) Avail: NTIS CSCL 14/5

The hardware design and an algorithm for equal probability quantizing on the IDECS/PDP are reported. The PDP 15/20 computer is interfaced to the IDECS (Image Discrimination Enhancement and Combination System) which is an analog-digital near real time image processing system. A brief description of the IDECS is provided. The addition of the designed hardware will make it possible to input film images to the IDECS/PDP and perform both quantizing and processing. Author (GRA)

N73-11415# National Swedish Inst. for Building Research, Stockholm.
GUARDED HOT PLATE APPARATUS FOR THE INVESTIGATION OF THERMAL INSULATIONS
Claes G. Bankvall 1972 78 p refs
(PB-210118; D5-1972) Avail: NTIS HC $3.00; Svensk Byggtjanst, Box 1403, S-111 84 Stockholm, Sweden: HC SW.KR. 18 CSCL 14B

The construction and properties of a guarded hot plate apparatus for the investigation of thermal insulations are described. The report begins with a general discussion of the methods used for measuring the thermal insulation capacity of a material and the principles of measurement applied when using a guarded hot plate apparatus. This is followed by a description of the construction of the new guarded hot plate apparatus and a detailed record of its performance. The report concludes by giving a few examples of measurements performed. Author (GRA)

N73-11416# Naval Air Development Center, Warminster, Pa. Aero-Electronic Technology Dept.
NAVY FLIGHT EXPERIMENT OF SECANT TRANSPONDER CORRELATION RANGING EQUIPMENT Final Report
James L. Hinds, Michael G. Raditz, and Oscar Shames 27 Jul. 1972 70 p refs
(AD-746448; NADC-72112-AE) Avail: NTIS CSCL 14/2

Flight tests of portions of an airborne collision avoidance system designated as SECANT were conducted. The feasibility of a random sequence binary correlator, digital range and range rate tracker was established. Further testing of a complete system is recommended. Author (GRA)

N73-11417# General Motors Corp., Indianapolis, Ind. Detroit Diesel Allison Div.
EVALUATION OF IRIDIUM/RHODIUM INTEGRATED PROBE/FLUIDIC SENSOR CONCEPT Final Report, 7 Jul. 1971 - 30 Apr. 1972
Joseph E. Whicker Wright-Patterson AFB, Ohio AFAPL Jun. 1972 122 p refs
(Contract F33615-71-C-1882; AF Proj. 3066)
(AD-745987; EDR-7470; AFAPL-TR-72-48) Avail: NTIS CSCL 14/2

An integrated probe/fluidic temperature sensor designed by the Air Force Aero Propulsion Laboratory was fabricated from iridium/rhodium noble metal alloy. Two fluidic sensors fabricated from iridium/rhodium were successfully calibrated from 1000 to 3000 F at 4 and 6 atmospheres. Transient response tests conducted at 4 atmospheres showed that the integrated probe/fluidic sensor responded much faster to step temperature changes than burner rig thermocouples but was slower than the thermocouples in reaching a stabilization temperature. One fluidic sensor was operated at 3000 F for one hour without any deviation from its calibration frequency. Author (GRA)

N73-11418# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics and Materials Science.
AN ULTRASONIC TECHNIQUE FOR DETECTION OF THE ONSET OF FATIGUE DAMAGE Annual Report, 1 Mar. 1971 - 29 Feb. 1972
Robert E. Green, Jr. and Robert B. Pond, Sr. Jun. 1972 41 p refs
(Contract F44620-71-C-0062; AF Proj. 9782)
(AD-745978; AFOSR-72-1199TR; AR-1) Avail: NTIS CSCL 14/2

The purpose of the present research is to develop an ultrasonic technique for the detection of the onset of fatigue damage. Particular emphasis is placed on the use of ultrasonic attenuation measurements as a continuous monitor of fatigue damage during cyclic testing of metal specimens. Efforts to date have indicated that the history of attenuation during fatigue of the specimen provides an index as to the onset of failure. Ultrasonic attenuation measurements made simultaneously with fatigue tests on aluminum bars give an early warning of eminent fracture. Such a warning occurs much earlier than detection of energy reflected from the crack by conventional ultrasonic techniques. This is true for specimens which were initially defect free and for those which initially had structural defects. Author (GRA)

N73-11419# Army Weapons Command, Rock Island, Ill. Weapons Lab.
INFRARED NONDESTRUCTIVE TESTING OF LAMINATED STRUCTURES AND ELECTRICAL CIRCUITS
George E. VanDamme and James W. McGarvey Jun. 1972 29 p refs
(DA Proj. 1T0-61101-A-91-A)
(AD-746233; SWERR-TR-72-35) Avail: NTIS CSCL 14/2

Infrared nondestructive testing (IRNDT) techniques and instrumentation were used successfully to detect unbonded areas in laminated structures. A high-speed infrared camera was used to monitor the thermal signature of the samples while they were being heated. Two methods of external sample heating were used in the IRNDT investigations, a 35 watt, continuous wave, CO2 laser and a 250 watt infrared lamp. The results obtained with each heat source were compared to determine the relative merits of each, and results are presented. The infrared camera was also used to detect an incipient failure in the electrical circuit board of a digital voltmeter. Author (GRA)

N73-11420# Brown Univ., Providence, R.I. Engineering Materials Research Lab.
A LOW INTERACTION TENSION (OR COMPRESSION)-TORSION LOAD CELL
Michael J. Michno, Jr., William N. Findley, and Ray M. Reed Mar. 1972 8 p refs
(Contract N00014-67-A-0191-0003; NR Proj. 064-424)
(AD-746471; EMRL-50; TR-15) Avail: NTIS CSCL 14/2

A load cell for combined axial load and torque having good sensitivity and repeatability and low cross talk is described. The instrument consists of a maraging steel tube with gimbal mounted direct-current differential transformers to sense the axial deflection and twist of the tube. Free-flex pivots were used in the gimbals to minimize friction. Author (GRA)

N73-11421# Virginia Univ., Charlottesville. Dept. of Physics.
NEW MODEL SYSTEMS FOR RESEARCH ON PHOTOGRAPHIC SENSITIVITY Final Report, Jun. 1969 - Apr. 1972
J. W. Mitchell and H. Hada Jun. 1972 100 p refs
(Contract F33615-69-C-1884; AF Proj. 7646)
(AD-746294; AFAL-TR-72-153) Avail: NTIS CSCL 14/5

Two new model systems have been developed for research on photographic sensitivity with crystals of silver chloride, bromide, chlorobromides and bromoidides. Thin square tabular crystals with sides of several hundred microns have been grown from aqueous solvent mixtures, saturated with the silver halides, and containing ethylamine, monoethanolamine, pyridine, and ammonium hydroxide. Such crystals can be produced over the whole range of silver chlorobromide compositions and with up to 5 mol% silver iodide in silver bromide. Epitaxial overgrowths of silver chloride, silver bromide, and of silver chlorobromides and bromoidides have been produced on melt-grown silver chloride, silver chlorobromide and silver bromide substrates, from saturated solutions of the halides in monoethanolamine-water mixtures. The distribution of the internal latent image and of internal photolytic sensitivity with both types of overgrowth has been studied. The microcrystals and both types of overgrowth have been chemically sensitized and optically sensitized for the formation of a surface latent image, which is revealed by either chemical or physical development. With these two new model systems, it should be possible to resolve a considerable number of outstanding problems in photographic sensitivity.
Author (GRA)

N73-11422# Naval Postgraduate School, Monterey, Calif.
ON-LINE DATA ACQUISITION AND INSTRUMENTATION IMPROVEMENTS FOR THE TRANSONIC TURBINE TEST

RIG M.S. Thesis
John Victor DeThomas Mar. 1972 114 p refs
(AD-746727) Avail: NTIS CSCL 14/2

The Transonic Turbine Test Rig located in the Turbo-Propulsion Laboratory of the Naval Postgraduate School is used to analyze axial turbine stage performance. The test rig is designed to separately measure stator and rotor losses without the use of velocity or pressure surveys. Various stator and rotor blade types can be investigated over wide ranges of axial and radial blade clearances in addition to variations in normal operating parameters. The report describes the development of on-line data acquisition and analysis for the Turbo-Propulsion Laboratory in conjunction with the turbine test rig. It also describes various improvements to the turbine test rig itself. Author (GRA)

N73-11423# Naval Ordnance Lab., White Oak, Md.
STRIKE CAMERA SURVEY
Charles G. Grover and Frank H. Pierce, III 1 Jun. 1972 51 p refs
(AD-746837; NOLTR-72-59) Avail: NTIS CSCL 14/5

The problem of photographically recording aircraft strikes is considered from the standpoint of the photographic instrumentation required. Emphasis is placed on recording guided weapon strikes during air-to-air encounters. Currently used and available techniques are enumerated and their advantages and disadvantages are discussed. Recommendations are made for continuing lines of investigation aimed at determining by test, the true usefulness of two of the techniques reviewed which are not currently in use. The appendices give background technical data on resolution required for aircraft detection, and optical problems involved in implementing the recommended techniques. Author (GRA)

N73-11424# Naval Scientific and Technical Intelligence Center, Washington, D.C. Translation Div.
CERTAIN NEW POSSIBILITIES OF PRODUCING PRECISION SENSORS OF OPTICAL TRACKING SYSTEMS
S. M. Konovalov, V. I. Lalabekov, and E. P. Chunbarov 30 Jun. 1972 16 p refs Transl. into ENGLISH from "Sovrem. Probl. Kibernetiki" USSR, Izd-vo Nauk, 1970 p 399-406
(AD-746742; NAVSTIC-Trans-3321) Avail: NTIS CSCL 17/8

Contents: Physical bases of sensor operation; Operating principle of sensors of optical tracking systems of the deflector type; Operational principle of the sensor for an optical tracking system of the diffraction type; Experimental study of sensors of optical tracking systems of the deflector and diffraction type. GRA

N73-11425# Ohio State Univ., Columbus. Electroscience Lab.
INVESTIGATION OF 10.6 MICRON PROPAGATION PHENOMENA. DUAL CHANNEL INFRARED SCANNER Quarterly Report, 8 Oct. 1971 - 8 Jan. 1972
William G. Swarner Griffiss AFB, N. Y. RADC Mar. 1972 175 p refs
(Contract F30602-70-C-0003; ARPA Order 1279)
(AD-747053; ESL-2880-6; RADC-TR-72-157) Avail: NTIS CSCL 20/6

The 2-channel infrared scanning, display, and recording system for measurement of rapidly varying atmospheric effects on image transmission and for experiments in image restoration has been completed and successfully tested. The report provides complete documentation for the system including a general description, specifications, installation and operating procedures, theory of operation, logic and wiring diagrams, and alignment and maintenance procedures. Author (GRA)

N73-11426# Aerojet Solid Propulsion Co., Sacramento, Calif.
DEVELOPMENT OF A NONDESTRUCTIVE TESTING TECHNIQUE TO DETERMINE FLAW CRITICALITY Final Report, 1 Mar. 1969 - 30 Jun. 1971
C. E. Harbower, C. F. Morais, and W. G. Reuter Jan. 1972 243 p refs
(Contract F33615-68-C-1705)
(AD-747225; AFML-TR-71-218) Avail: NTIS CSCL 14/2

The report presents the findings of a study to develop a nondestructive testing technique to determine flaw criticality based upon stress-wave emission. The research included an evaluation of various sensors and instrumentation systems, and several materials and material conditions tested to failure in rising load and low-cycle, high-stress-intensity fatigue. The fracture testing utilized a linear-elastic fracture-mechanics approach. Acoustic emission was the basis of the nondestructive inspection technique. The stress-wave-analysis technique (SWAT) was shown to be a highly sensitive nondestructive inspection method, capable of detecting growing defects at least an order of magnitude smaller than any other known NDI method and, with a computerized system, capable of locating one or more defects in real time. Author (GRA)

N73-11427# Purdue Univ., Lafayette, Ind. Applied Optics Lab.
BIBLIOGRAPHY ON LASER DOPPLER VELOCIMETERS: THEORY, DESIGN AND APPLICATIONS
Warren H. Stevenson, Michael K. Pedigo, and Ronald E. Zammit 6 Jul. 1972 40 p refs
(Contract DAAH01-72-C-0089; DA Proj. 1M2-62303-A-2)
(AD-746634; RD-TR-72-8) Avail: NTIS CSCL 14/2

A bibliography containing over 190 references on various aspects of laser Doppler velocimeter theory and usage is presented. Author (GRA)

N73-11840* Michigan Univ., Ann Arbor.
PHOTOMETRY OF COMETS
Freeman Miller *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 48-50 refs (For availability see N73-11833 02-30)
CSCL 14E

N73-11841* National Aeronautics and Space Administration, Washington, D.C.
L ALPHA PHOTOMETRY OF COMET BENNETT
Maurice Dubin *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 51-54 refs (For availability see N73-11833 02-30)
CSCL 14E

N73-11842* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMMENTS ON PHOTOCHEMISTRY
B. D. Donn *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 55-56 refs (For availability see N73-11833 02-30)
CSCL 14E

N73-11843* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FURTHER COMMENTS ON PHOTOCHEMISTRY
W. M. Jackson *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 57-58 ref (For availability see N73-11833 02-30)
CSCL 14E

N73-11854* Arizona Univ., Tucson. Lunar and Planetary Lab.
PHOTOGRAPHIC OBSERVATIONS OF COMET BENNETT, 1970II
S. M. Larson and R. B. Minton *In its* Comets: Sci. Data and Missions 1 Jul. 1972 p 183-208 refs (For availability see N73-11833 02-30)
(Grant NGL-03-002-002)
CSCL 14E

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control; reliability; drafting; and materials fabrication, handling, and inspection.

N73-11428 Engineering Sciences Data Unit, London (England).
DESIGN OF PARALLEL AXIS STRAIGHT SPUR AND HELICAL GEARS: CHOICE OF MATERIALS AND PRELIMINARY ESTIMATE OF MAJOR DIMENSIONS
Sep. 1968 8 p refs Sponsored by Inst. of Mech. Engr.

(ESDU-68040-Amend-A) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Data are given for gears generated from the 20 deg flank rack form, which enable an initial estimate to be made of the major gear dimensions required for a specified torque and gear ratio. General guidance is given on the choice between metallic and nonmetallic gear materials. Author

N73-11429 Engineering Sciences Data Unit, London (England).
GUIDE TO THE DESIGN OF TANKS FOR FORCED CIRCULATION OIL LUBRICATION SYSTEMS
1 Jul. 1968 12 p refs Sponsored by Inst. of Mech. Engr.
(ESDU-68039) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A description is given of a tank designed to provide storage for oil, allow settling of solid and liquid contaminants, and promote de-areation and foam removal in forced circulation oil lubricating systems. Data are also provided for the function of various constituent components used in the tanks. E.H.W.

N73-11430 Engineering Sciences Data Unit, London (England).
DESIGN OF PARALLEL AXIS STRAIGHT SPUR AND HELICAL GEARS: BACKLASH AND INSPECTION DIMENSIONS
1 May 1968 14 p refs Sponsored by Inst. of Mech. Engr.
(ESDU-68028) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A procedure for selecting a suitable value for backlash and determining the dimensions required to check tooth thickness is outlined. Guidance on the choice of backlash is presented, as well as formulas for calculating the normal arc thickness of the teeth at the reference cylinders of defined gears, which meshed together with standard depth of engagement of teeth, conjugate to a British Standard rack of specified normal pitch. Other dimensions required to check the thickness by various methods of measurement are also given. These methods include (1) use of gear tooth calipers, (2) measurement of base tangent over any practicable number of teeth, and (3) measurement over rollers of any predetermined diameter for which the method is practicable. Author

N73-11431 Engineering Sciences Data Unit, London (England).
CALCULATION METHODS FOR STEADILY LOADED PRESSURE FED HYDRODYNAMIC JOURNAL BEARINGS
Sep. 1966 70 p Sponsored by Inst. of Mech. Eng.
(ESDU-66023) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Calculation methods and charts are given to aid in the design of steadily loaded, pressure fed, 360 deg hydrodynamic journal bearings lubricated by liquids. A description of a design procedure is given, together with working figures; supplementary information on and explanation of various aspects of the design. Three examples are also given illustrating the application of the memorandum to particular bearing designs. Author

N73-11432 Engineering Sciences Data Unit, London (England).
COMPUTER SERVICE FOR PREDICTION OF PERFORMANCE OF STEADILY LOADED PRESSURE FED HYDRODYNAMIC JOURNAL BEARINGS
Jan. 1969 11 p refs Sponsored by Inst. of Mech. Engr.
(ESDU-69002-Amend-A) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Data sheets for computerized prediction of hydrodynamic journal bearing performance are reported. A specimen data input form with a program flow chart outline is given, and an example calculation on a steadily loaded pressure fed hydrodynamic journal bearing is outlined. G.G.

N73-11433 Engineering Sciences Data Unit, London (England).
SHAFTS WITH INTERFERENCE-FIT COLLARS. PART 3: PROCEDURE FOR CALCULATION OF NOMINAL ELASTIC INTERFACE PRESSURES AND STRESSES IN ASSEMBLIES OF THREE OR MORE ELEMENTS
Mar. 1968 8 p Sponsored by Inst. of Mech. Eng.
(ESDU-68004-Pt-3) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A procedure for calculating the nominal interface pressure and stresses in a lot of three or more uniform circular rings with axially uniform initial interferences is given. The effects of uniform temperature rise and rotation are also considered. The procedure is based on plane stress elastic theory. Author

N73-11434 Engineering Sciences Data Unit, London (England).
SHAFTS WITH INTERFERENCE-FIT COLLARS. PART 4: FATIGUE STRENGTH OF PLAIN SHAFTS
Jan. 1968 6 p refs Sponsored by Inst. Mech. Engr.
(ESDU-68005-Pt-4) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The results of about 170 fatigue tests on solid shafts with interference-fit collars have been analyzed. The shafts were all of constant diameter over the test section. The collars were effectively plain. The shafts were subjected to rotating bending loads transferred through the collars in all except a few cases in which the collars were unloaded. The mode of failure was shaft fracture at or just inside the face of the collar. However, virtually all the unbroken shafts contained surface cracks under the outer regions of the collars where the small relative movement between shaft and collar can cause fretting to occur. Nickel or manganese alloy steels were used for the forgings from which the shafts were made and the collars were made from cast or forged alloy steels. Author

N73-11435 National Lending Library for Science and Technology, Boston Spa (England).
HARD ALLOY TOOLS FOR COLD SHAPING STEEL AND NON-FERROUS METALS
W. Kraft 28 Jul. 1972 7 p Transl. into ENGLISH from TZ Prakt. Metallbearb. (West Germany), v. 64, 1970 p 240-244
(NLL-NEL-TT-2400-(6075.461)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The economics of using hard alloy shaping tools for cold shaping, particularly extrusion shaping, is discussed. The use of these alloys to cold shape steel and nonferrous materials is included. E.H.W.

N73-11436 National Lending Library for Science and Technology, Boston Spa (England).
COMPUTER-AIDED PLANNING OF COLD FORGING PRODUCTION PROCESSES
D. D. Kulikov 28 Jul. 1972 10 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Priborostr. (Leningrad), no. 4, 1970 p 111-113 In ENGLISH and RUSSIAN
(NLL-NEL-TT-2393-(6075.461)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Some systems are considered for the automatic planning of production processes. Their faults are indicated and a system is proposed which is capable of being improved, while its algorithms are being operated. Author

N73-11437*# United Aircraft Corp., East Hartford, Conn. Research Labs.
DEVELOPMENT OF HIGH TEMPERATURE FASTENERS USING DIRECTIONALLY SOLIDIFIED EUTECTIC ALLOYS Final Report
F. D. George 23 Aug. 1972 70 p refs
(Contract NAS8-27358)
(NASA-CR-123919; L911174-11) Avail: NTIS HC $5.50 CSCL 13E

The suitability of the eutectics for high temperature fasteners was investigated. Material properties were determined as a function of temperature, and included shear parallel and perpendicular to the growth direction and torsion parallel to it. Techniques for fabricating typical fastener shapes included grinding, creep forming, and direct casting. Both lamellar Ni3Al-Ni3Nb and fibrous (Co,Cr,Al)-(Cr,Co)7C3 alloys showed promise as candidate materials for high temperature fastener applications. A brief evaluation of the performance of the best fabricated fastener design was made. Author

N73-11438# Defence Standards Labs., Maribyrnong (Australia).
ON THE BEHAVIOR OF ELASTIC DIAPHRAGMS SUBJECTED TO ACCELERATION IN THE PLANE OF THE DIAPHRAGM
C. I. Sach Aug. 1972 26 p refs
(Rept-519) Avail: NTIS HC $3.50

The displacement of points on the surface of a circular, edge-clamped diaphragm subjected to a uniform acceleration in the plane of the diaphragm is evaluated. It is found that the component of displacement normal to the direction of the applied acceleration is zero. It is then shown that this result does not apply to a circular annulus clamped on its inner and outer edges. The conditions giving rise to zero displacement are examined, and it is shown that a necessary condition is that the boundary contour belongs to a restricted class of conic sections. However, when stress levels are considered, it is found that the only allowable boundary is the ellipse. The results are used to investigate the conditions leading to zero cross-axis sensitivity of accelerometers using strain-gauged, circular diaphragms as the sensing element. Author

N73-11439# Technische Universitaet, Brunswick (West Germany).
INVESTIGATIONS OF A SEMIAXIAL COILED CASING PUMP WITH TURBINE WHEELS OF DIFFERENT NUMBERS OF BLADES AND ANGLES OF EMERGENCE Ph.D. Thesis [UNTERSUCHUNGEN AN EINER HALBAXIALEN SPIRALGEHAEUSEPUMPE MIT LAUFRAEDERN VERSCHIEDENER SCHAUFELZAHL UND AUSTRITTSWINKEL]
Engelbert Schmiedl 1971 93 p refs In GERMAN
Avail: NTIS HC $6.75

Mechanical, wheel friction, and gap width losses and their effects on the performance of a semiaxial pump having various impeller blade arrangements are considered. Experimental and theoretical studies show that all losses are minimal for this type of pump; but increased gap width affects feed flow, feed height, and the degree of pump effectiveness. An axial shift of the rotor wheel increases gap width losses. Transl. by G.G.

N73-11440*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A SURVEY OF AN INTRODUCTION TO FAULT DIAGNOSIS ALGORITHMS
F. P. Mathur 1 Oct. 1972 39 p refs
(Contract NAS7-100)
(NASA-CR-129095; JPL-TM-33-567) Avail: NTIS HC $4.00 CSCL 14D

This report surveys the field of diagnosis and introduces some of the key algorithms and heuristics currently in use. Fault diagnosis is an important and a rapidly growing discipline. This is important in the design of self-repairable computers because the present diagnosis resolution of its fault-tolerant computer is limited to a functional unit or processor. Better resolution is necessary before failed units can become partially reuseable. The approach that holds the greatest promise is that of resident microdiagnostics; however, that presupposes a microprogrammable architecture for the computer being self-diagnosed. The presentation is tutorial and contains examples. An extensive bibliography of some 220 entries is included. Author

N73-11441*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PERFORMANCE OF 40-MILLIMETER-BORE BALL BEARINGS WITH LEAD- AND LEAD-ALLOY-PLATED RETAINERS IN LIQUID HYDROGEN AT 1.2 MILLION DN
David E. Brewe, Donald W. Wisander, and Herbert W. Scribbe Washington Nov. 1972 18 p refs
(NASA-TN-D-6981; E-6916) Avail: NTIS HC $3.00 CSCL 13I

Forty-millimeter-bore ball bearings with lead- and lead-alloy-coated retainers were operated in liquid hydrogen at 30,000 rpm under a thrust load of 1780 N (400 lb.) Four different substrate materials were used for the retainer. Longer bearing run times were achieved with a lead-tin-copper alloy coating plated onto a leaded-bronze material (22.5 hr) and an aluminum-bronze alloy (19.3 hr). One bearing with a pure lead coating achieved the desired objective of 10 hr. This bearing had an aluminum - bronze substrate retainer and ran successfully for 12.4 hr. Additions of antimony to the lead provided an alloy coating with better wear resistance than pure lead; however, this coating was abrasive to the outer-race lands. Author

N73-11442*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DIGITAL CONTROLLER FOR A BAUM FOLDING MACHINE Patent Application
Wayne H. Bryant, inventor (to NASA) Filed 1 Sep. 1972 32 p
(NASA-Case-LAR-10688-1; US-Patent-Appl-SN-285705) Avail: NTIS HC $3.75 CSCL 13I

The design is described of a digital control system which provides automatic counting of the sheets to be folded and attendant shutoff of the machine when the selected count is reached. The system consists of an operator controlled selector for producing a decimal output representing the desired number of sheets of pages to be folded as selected by the operator, and an encoder which converts the selector output into a corresponding number according to a selected digital code. A buffer register stores the coded output and continuously presents the stored output to a counter. Before starting the folding process, the contents of the buffer register are loaded into decade counters. A sensor detects the passage of the sheets to be folded and the decade counter decreases its contents accordingly. When the decade counter counts down to a predetermined number, an output signal is produced which terminates the operation of the machine. D.L.G.

N73-11443*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LATCH MECHANISM Patent Application
Larry P. Ratcliff, inventor (to NASA) Filed 26 Oct. 1972 25 p
(NASA-Case-MSC-12549-1; US-Patent-Appl-SN-301039) Avail: NTIS HC $3.25 CSCL 13E

A latching mechanism is described which has a latch member which will collapse when a latching surface is passed over the latch member as it is brought into a position to engage the latch member and which will return and automatically engage the latching surface as the latching surface passes completely by the latch member. The latch member is pivotally attached to a linking member which is pivotally mounted in a housing. This arrangement makes the release and disengagement of the latch member from the latching surface easier and more expedient than was possible with prior capture latches. The improved capture latch is an improved spacecraft ring and finger mechanism which will provide substantially fail safe operator latching. NASA

N73-11444# Boeing Co., Seattle, Wash. Commercial Airplane Group.
STRESS DISTRIBUTION AND DISPLACEMENTS IN A LUBRICATED ELASTIC SEAL
Edward F. Ehlers 11 Sep. 1972 33 p refs Backup document for AIAA Synoptic, "The Stress Distribution and Displacements in a Lubricated Elastic Seal", scheduled for publication in the Journal of Aircraft in Jan. 1973
Avail: NTIS HC $3.75

The Milne-Thomson complex variable method of planar elastic stress was applied to find the stresses and displacements in an elastic seal of rectangular cross section. Surfaces of the seal touching the shaft and housing were assumed to be lubricated. The solution of the integral equation for a semi-infinite seal was found, and detailed calculations of the stresses and displacements in the vicinity of the air gap near the shaft are presented. Author

N73-11445*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ULTRASONIC SCANNING SYSTEM FOR INSPECTION OF BRAZED TUBE JOINTS
J. L. Haynes and N. A. Maurer 15 Oct. 1972 37 p
(NASA-TM-X-64702) Avail: NTIS HC $4.00 CSCL 14D

An ultrasonic scanning system used to inspect and evaluate in-place brazed tube joints is considered. The system was designed, developed, and built especially for nondestructive testing and was selected because of its known response to brazing defects not associated with material density changes. The scan system is capable of scanning brazed joints in union, tee, elbow and cross configuration of 3/16-inch through 5/8-inch diameters. It is capable of detecting brazed defects as small as 0.008 by

0.010-inch, which exceeds the 0.015-inch diameter defect resolution required by specification. Author

N73-11446# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE MAGNITUDE OF THE TRANSVERSE FORCE ACTING ON THE IMPELLER OF CENTRIFUGAL PUMPS
N. K. Gladchenko 1972 6 p refs Transl. into ENGLISH from Izv. Vtssh. Ucheb. Zaved., Aviats Tekh. (Kazan), no. 2, 1972 p 92-99
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The influence of radial and dynamic pressure magnitude on bearing rupture in centrifugal pump impellers of aircraft fuel systems is measured. Two systems with different snail geometries were used. E.H.W.

N73-11447# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.
ELASTIC TENSILE STRESSES IN BOW SHACKLES OF CIRCULAR SECTION
D. W. Martin and Margaret A. Wagland Jun. 1972 26 p refs
(NPL-NAC-17) Avail: NTIS HC $3.50

Tensile stresses of shackles have been computed on the assumption that the deformation is elastic, that the strain energy due to bending is proportional to integral MZds and that the strain energy due to direct stress and shear is negligible. The results of the computations are presented in tabular form. Author (ESRO)

N73-11448# Defence Research Information Centre, Orpington (England).
ELECTRIC ARC WELDING OF TIN AND ALUMINIUM BRONZES AND SILICON BRASS
I. P. Doronin et al Sep. 1972 13 p refs Transl. into ENGLISH from Svarochn. Proizv. (Moscow), v. 1, no. 3, Mar. 1955 p 18-21
(DRIC-Trans-2843; BR-30218) Avail: NTIS HC $3.00

The electric arc welding of tin and aluminum bronzes and silicon brass is discussed. The composition of the electrodes, homogeneity of the welded joints, chemical composition of the metal, hardness of the metal seam, and color of the fused metal are also discussed. Author (ESRO)

N73-11449# Battelle Columbus Labs., Ohio.
EFFECTIVE TOOLING DESIGNS FOR PRODUCTION OF PRECISION FORGINGS Final Engineering Report, 1 Mar. 1970 - 30 Apr. 1972
James R. Becker, James R. Douglas, and Fred A. Simonen Wright-Patterson AFB, Ohio AFML Jun. 1972 106 p refs
(Contract F33615-70-C-1437; AF Proj. 128-0)
(AD-745991; AFML-TR-72-89) Avail: NTIS CSCL 13/9

The aim of the two-phase program is to demonstrate that nonsymmetric rib-and-web type configurations can be hot forged to precision dimensions with better die life through the use of reinforcing components surrounding the die inserts. Efforts consisted of (1) a review of the literature on precision forging where die breakage has been a problem, (2) visits to five leading forging companies active in precision forging and companies active in Government-sponsored research on forging, (3) selection of a part configuration for design, (4) analytical modeling studies of stress distribution in the die assembly, (5) developing the preform design through the use of Plasticine and hard plastic dies, (6) conducting forging trials in model dies instrumented with strain gages, and (7) conducting hot forging trials on aluminum, AISI 4340 steel, and Inconel 718 alloys in Battelle's 2500-ton press. Author (GRA)

N73-11450# Pennsylvania State Univ., University Park. Dept. of Mechanical Engineering.
AN INVESTIGATION OF THE DYNAMIC RESPONSE OF ANALOG FLUID AMPLIFIERS Final Report, 1 Sep. 1969 - 31 Aug. 1971
Anthony J. Healey Sep. 1971 20 p refs
(Contract DAHC04-69-C-0083)
(AD-746274; AROD-8721-1-E) Avail: NTIS CSCL 13/7

Results and conclusions of fluidic devices dynamic response analysis are reported in three parts. The first deals with a hybrid computer simulation of a complete amplifier, the second part deals with the recovery and spillover process in and around receivers, and the third part deals with the dynamic response of a rectifier for future use as a high frequency to analog conversion device in advanced FM sensing systems. Author (GRA)

N73-11451# Florida Univ., Gainesville. Dept. of Industrial and Systems Engineering.
GENERALIZED RELIABILITY METHODS FOR SYSTEMS WITH STANDBYS
Darrell G. Linton and Z. R. Stojanovic May 1972 92 p refs
(Contract DAHC04-68-C-0002)
(AD-745911; TR-65; AROD-T-1-91-RT) Avail: NTIS CSCL 14/4

For repairable systems with standbys, several candidates for measuring reliability are (1) the time to system failure, (2) the number of repairs completed before failure and (3) the total time spent on repair before failure. In the report some general procecures are developed for studying these and other reliability characteristics of systems with standbys. Emphasis is placed on a class of repairable systems known as k-out-of-n systems, 1 < or = k < or = n, parallel redundancy are serviced by a single repairman and system failure occurs when k units are simultaneously inoperable for the first time. Author (GRA)

N73-11452# Lehigh Univ., Bethlehem, Pa. Fritz Engineering Lab.
FORMATION OF THE WELD DEPOSIT AND ITS EFFECT ON THE ALL WELD METAL HEAT AFFECTED ZONE
Morton M. Perle Jul. 1972 222 p refs
(Contract N00014-68-A-0514; NR Proj. 064-509)
(AD-746886; FEL-358.38) Avail: NTIS CSCL 13/8

The three-dimensional shape of a gas metal-arc weld puddle was graphically constructed using a centerline section of a hammer decanted weld, a weld cross-section and the top surface crater outline of the weld puddle. Velocities of melting and solidification were computed at every point within the weld puddle. The analysis showed that the weld papillary region typically solidified 19 times as fast as the trailing portions of the weld puddle and that the arc jet effect causes papillary penetration. Lateral melting of the weld bead is caused by liquid circulation. Etching with sodium bisulfite solutions revealed patterns of weld solidification segregation. Microprobe study showed that these patterns were evidences of segregation of nickel, manganese, silicon and molybdenum in the last interdendritic liquid to solidify. The forms of solidification structure change from cellular to columnar dendrites with decreasing solidification velocity. Author (GRA)

N73-11453# Texas Univ., Austin. Structures Fatigue Research Lab.
STATIC AND FATIGUE BEHAVIOR OF TUBULAR CONNECTIONS: A SUMMARY REPORT Final Report, 1967 - 1971
A. A. Toprac Apr. 1972 40 p refs
(Contract NBy-53143)
(AD-746894; SFRL-TR-P550-12) Avail: NTIS CSCL 13/5

In this final report the findings of research studies on the subject of tubular joints are presented. The report covers both static and fatigue strength of welded hollow, round shapes. After an introduction and a literature review of theoretical and experimental findings, design considerations are presented for the static strength and fatigue life of such connections. Suggested design curves indicate the static strength of tubular joints with yield strength and a thickness parameter as influence factors. S-N curves (stress range vs cycles to failure) for the fatigue life of T-and K-connections are also presented. It is believed that the data could be used in the design of tubular structures if dimensional ratios are about equal to those of the program. Author (GRA)

N73-11454# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF THE DEFORMATION OF AN OPERATING JET ON THE CHARACTERISTICS OF AN EJECTOR JET PUMP
G. A. Petukhova 7 Apr. 1972 12 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavendenii, Energ. (Minsk), no. 3, 1971 p 74-78
(AD-747079; FTD-HT-23.1350.71) Avail: NTIS CSCL 13/11

A procedure is outlined for calculating the characteristics of

jet devices operating on incompressible fluids, with account taken of deformation of the working jet at the inlet section of a conical mixing chamber. Experimental data on the characteristics of jet pumps are presented and practical recommendations are made on the use of the proposed equation. Author (GRA)

N73-11455# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF METAL TEMPERATURE ON THE COEFFICIENT OF FRICTION DURING COLD ROLLING
A. P. Grudev, Yu. V. Zilberg, and V. A. Bondarenko 16 Jun. 1972 10 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 1, 1971 p 80-81
(AF Proj. 7343)
(AD-746935; FTD-MT-24-2057-71) Avail: NTIS CSCL 13/8

Earlier papers dealing with friction in cold rolling have failed to take into account the role of the temperature factor, although the temperature of the metal sometimes rises to 250 to 300 degrees C, which drastically affects the properties of lubricants. This study discusses the effect of the metal's temperature on the friction factor in cold rolling within 20 to 250 degrees C. The lubricants were castor and spindle oils. The experiment involved specimens of 08 KP work hardened steel rolled on a DUO mill on hardened steel rolls 191.1 mm in diameter at a reduction in area of 10 percent. Author (GRA)

N73-11456# Massachusetts Inst. of Tech., Cambridge. Materials Processing Lab.
THE TEMPERATURE OF SLIDING SURFACES Annual Report, 1 Jun. 1971 - 31 May 1972
Nathan H. Cook and Bharat Bhushan May 1972 32 p refs
(Contract N00014-67-A-0204-0054; NR Proj. 229-003)
(AD-746830) Avail: NTIS CSCL 20/11

An analysis is proposed for estimating the average interface temperature rise during sliding of two surfaces. The basic model includes surface topography statistics, frictional conditions, the effective surface hardness, and thermal parameters. In 75% of the material pairs studied, the analysis gives fairly good results. It appears applicable to either dry or lubricated surfaces. In particular, good correlation was obtained with the following material pairs: Brass-steel, cast iron-steel, graphite steel, tungsten carbide-steel, babbit-steel, titanium-magnesium, nickel-magnesium, and graphite-aluminum. Sliding speeds ranged up to 100 in/sec, average contact stresses typically were in the 25-250 psi range, and temperature rises up to 200 F were observed. Author (GRA)

N73-11457# Columbia Univ., New York. Lubrication Research Lab.
LUBRICATION THEORY FOR NEWTONIAN FLUIDS WITH STRIATED ROUGHNESS OR GROOVING
Harold G. Elrod Aug. 1972 25 p refs
(Contract N00014-67-A-0108-0021)
(AD-747307; Rept-21) Avail: NTIS CSCL 09/2

Earlier work by others concerning the effects of striated roughness and grooving upon the load-carrying capacity of lubricating films is summarized, substantiated and generalized. A multiple-scale double-variable technique is used on such lubrication problems for the first time. The present analysis applies to one-face roughness having striation wavelengths sufficiently long for the applicability of Reynolds equation. Transient effects are included. The final differential equation for support pressure is simple in form. In addition to predicting the effects of striated Reynolds roughness, this equation can be directly used in grooved-bearing design. Author (GRA)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State.

N73-11458 National Lending Library for Science and Technology, Boston Spa (England).
A CHEMICAL LASER OPERATING ON MIXTURES OF FLUORINE AND FLUORIDE OF NITROGEN WITH DEUTERIUM
N. G. Basov et al 10 Jul. 1972 15 p refs Transl. into ENGLISH from Kvantovaya Electon (USSR), no. 4, 1971 p 50-57
(NLL-DRIC-Trans-2816-(3623.66)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A study was made of the generation spectrum of excited molecules of DF obtained in the process of chemical reactions in D2 + F2, D2 + NF3, D2 + N2F4 and D2 + FNO2 mixtures at a pressure of about 1 torr (mm Hg). It was found that the greatest number of generation lines (including those in the 1-0 band) is observed in the case of a laser operating on a D2, + NF3 mixture. A study of the behavior of the intensity of the different lines in time made it possible to elucidate the features associated with the increase of the temperature of the mixture in the course of the reaction and with cascade transitions. Author

N73-11459 National Lending Library for Science and Technology, Boston Spa (England).
THE REFRACTIVE INDEX OF A GAS-DISCHARGE MEDIUM IN A CO2 LASER
O. A. Kolosovskii 10 Jul. 1972 7 p refs Transl. into ENGLISH from Kyantovaya Electron. (USSR), no. 4, 1971 p 107-109
(NLL-DRIC-Trans-2815-(3623.66)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

An explanation for the mechanism of the dependence of the refractive index of a gas discharge medium in a carbon dioxide laser on the discharge current is presented. The test equipment is described. Data resulting from the calculation of the variable component of the refractive index are developed. It is concluded that: (1) the refractive index of a gas-discharge medium in a carbon dioxide laser is determined by the basic concentration of unexcited molecules, (2) the characteristics of a refractive index decrease with a steepness in proportion to the increase of the discharge current, and (3) with frequencies of 2 to 10 KHz, the variable part of the refractive index will be determined by modulation of the concentration of free electrons. Author

N73-11460*# Hughes Research Labs., Malibu, Calif.
MODULATION AND DETECTION OF OPTICAL SIGNALS
F. E. Goodwin 11 Aug. 1972 25 p refs
(Contract NAS1-10894)
(NASA-CR-129181) Avail: NTIS HC $3.25 CSCL 20E

A summary of information is presented which is related to the modulation and detection of information on optical carriers. It emphasizes the treatment of information transfer through an entire system. The most common configurations are considered: intensity modulation, amplitude modulation, frequency or phase modulation, and both direct and coherent detection. In assessing these configurations information capacity and message signal-to-noise ratio are used as a basis of comparison. The physical and geometric treatment of optical heterodyne (or coherent) detection is given. Author

N73-11461# Weapons Research Establishment, Salisbury (Australia).
THE OPTICAL PROPERTIES OF LASER RESONATORS WITH A SPINNING PRISM Q SWITCH
B. A. See Jun. 1972 35 p refs
(WRE-TN-658(AP)) Avail: NTIS HC $3.75

The spinning prism Q switch is frequently used on solid state lasers as it is cheap, robust and reliable. The optical properties of resonators formed by a roof prism are presented. They are found to be equivalent to a flat mirror, but they have the additional feature of discriminating against even order modes. The preferred lowest order mode is the TEM sub 01q, having a null corresponding to the discontinuity of the roof edge. Author

N73-11462# Weapons Research Establishment, Adelaide (Australia).
OPTIMUM FLASH DURATION FOR A Q SWITCHED LASER
B. A. See Jun. 1972 13 p refs
(WRE-TM-657(AP)) Avail: NTIS HC $3.00

An electrical analogue model of a flash tube and laser rod system is presented. The model allows the efficiency of the system to be determined. It was determined that the stored energy in the laser rod is a rapidly falling function of the flash

duration. The flash duration should be as short as possible, while maintaining a reasonable life for the flash tube. Author

N73-11463# Defence Research Establishment, Valcartier (Quebec).
THE ANOMALOUS BLUE SHIFT OF LASER LIGHT SCATTERED BY A PLASMA
T. S. Brown Jun. 1972 17 p refs
(DREV-R-676/72) Avail: NTIS HC $3.00

An intense laser beam focused in a plasma is shown to generate a smoke ring of electrons at the focal spot. If the energy in the laser pulse exceeds a certain threshold, then the electrons on the axis of the smoke ring move towards the laser. This average electron motion results in an overall blue shift of the spectrum of incoherently scattered laser light. Author

N73-11464# Defence Research Establishment, Valcartier (Quebec).
PLASMA PARAMETERS IN TEA LASER DISCHARGES
T. S. Brown Jul. 1972 24 p refs
(DREV-TN-2025/72) Avail: NTIS HC $3.25

Typical values of parameters of the TEA laser discharge are estimated and the nature of the discharge is discussed. Author

N73-11465# Research Inst. of National Defence, Stockholm (Sweden).
ATTENUATION OF CO2 LASER BEAMS IN THE ATMOSPHERE
Kai Gullberg, Britt Hartmann, and Bengt Kleman Sep. 1971 78 p refs In SWEDISH; ENGLISH summary
(FOA-2-A-2542-E3/E4/E6) Avail: NTIS HC $6.00

The attenuation of a CO2 laser beam in the atmosphere is discussed. Various information from the literature and measurement data have been examined and are presented in a summary. Attenuation at 10.6 microns is compared with data from two other laser wave lengths, 3.5 and 0.63 microns. The attenuation factors include the molecular absorption which is unique since it is strongly dependent on wave length. In the case of CO2 the laser beam is in exact wave length coincidence with corresponding absorption bands in the atmosphere. An appendix gives basic formulas, basic data and methods for calculating the absorption coefficients for CO2 laser wave lengths from measured data. Author

N73-11466*# Scientific Translation Service, Santa Barbara, Calif.
ADAPTATION OF THE LIDAR TO AIRCRAFT AND MISSILE RANGEFINDING
Pierre Weber Washington NASA Nov. 1972 38 p refs Transl. into ENGLISH from Rech. Aerosp. (Chatillon), no. 1, Jan. - Feb. 1972 p 23-35
(Contract NASw-2035)
(NASA-TT-F-14716) Avail: NTIS HC $4.00 CSCL 20E

From its inception, the lidar has been considered as a remarkable localization instrument, due to its space and time coherence. The operating conditions of the lidar on satellites and on aircraft of missiles are compared. Means for adapting one case to the other are proposed. Results obtained with ONERA experimental lidars are presented: an accuracy of about 0.8 m and a reproducibility of about 1.3 m (rms) were obtained on a vehicle carrying corner reflectors. Author

N73-11467# Joint Publications Research Service, Arlington, Va.
NOISE IMMUNITY OF OPTICAL COMMUNICATION LINES (OLC) WITH FREQUENCY MULTIPLEXING OF DISCRETE INFORMATION CHANNELS
K. N. Shchelkunov and L. G. Kazovskiy 4 Oct. 1972 8 p refs Transl. into ENGLISH from Radiotekh. (Moscow), v. 27, no. 3, 1972 p 1-4
(JPRS-57178) Avail: NTIS HC $3.00

An analysis is presented of immunity to interference of the optical communication lines with subcarriers along with a comparison of its immunity to interference from time multiplexing of optical radiation pulses. Author

N73-11468*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A CURVE-FITTING TECHNIQUE FOR THE DETERMINATION OF GAIN AND SATURATION INTENSITY IN HOMOGENEOUSLY-BROADENED GAS LASERS: APPLICATION TO A WAVEGUIDE CO2 LASER
J. J. Degnan, H. E. Walker, J. H. McElroy, N. McAvoy, and T. Zagwodski Oct. 1972 21 p refs
(NASA-TM-X-66097; X-524-72-387) Avail: NTIS HC $3.25 CSCL 20E

A least squares curve-fitting algorithm is derived which allows the simultaneous estimation of the small signal gain and the saturation intensity from an arbitrary number of data points relating power output to the incidence angle of an internal coupling plate. The method is used to study the dependence of the two parameters on tube pressure and discharge current in a waveguide CO2 laser having a 2 mm diameter capillary. It is found that, at pressures greater than 28 torr, rising CO2 temperature degrades the small signal gain at current levels as low as three milliamperes. Author

N73-11469# Lockheed Missiles and Space Co., Palo Alto, Calif.
APPLICATION OF GASDYNAMIC FLOWS IN LASER TECHNOLOGY
V. N. Karniushin and R. I. Soloukhin 1972 48 p refs Transl. into ENGLISH from Fiz. Goreniya Vzryva (Novosibirsk), no. 2, 1972 p 162-202, 324
Avail: NTIS HC $4.50; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The effects of gas dynamic flows on the properties of laser systems are discussed. Technical documents pertaining to the gas dynamic effects are identified and summarized. The subjects discussed are: (1) production of laser active media upon mixing flows of chemically nonreacting gases, (2) molecular lasers with stream mixing and electrical discharge pumping, (3) molecular lasers with thermal pumping and resonance, (4) electrical discharge gas lasers with convective cooling of the working mixture, (5) pulsed lasers with stream cooling, and (6) operating principles of gas dynamic lasers. Author

N73-11470# Lockheed Missiles and Space Co., Palo Alto, Calif.
FLUCTUATIONS OF THE FIELD OF A LASER BEAM BEING PROPAGATED IN A TURBULENT ATMOSPHERE
V. L. Mironov and G. Ia. Patrushev 1972 8 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Radiofiz. (Gorki), v. 15, no. 6, 1972 p 865-871
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The dispersion, correlation, and structural functions of fluctuations in the logarithm of the amplitude and the phase of a laser beam being propagated in a turbulent atmosphere are analyzed numerically. The analysis is conducted by approximations of the smooth perturbation method as a function of the size of the radiating aperture, the radiation focusing conditions, and the coordinates of the points of observation in a plane perpendicular to the beam axis. The dependence of the correlation coefficient for fluctuations in the logaritm of the amplitude on the radius of curvature of the beam phase front in the plane of the exit aperture is shown. Author

N73-11471# Institut Franco-Allemand de Recherches, St. Louis (France).
HIGH-SPEED HOLOGRAPHY [HOLOGRAPHIE ULTRA-RAPIDE]
P. Smigielski, H. Fagot, A. Stimpfling, and J. Schwab 19 May 1971 16 p refs In FRENCH; ENGLISH summary
(Contract DMRE-71/104)
(ISL-10/71) Avail: NTIS HC $3.00

Holograms of large size, high speed phenomena were recorded in diffuse light using the beam from a synchronized, monomode and Q-switched ruby laser. An elliptical setup used to minimize the effects due to phase object motion is described. Three different experiments were carried out: description of the relief of a large size object, visualization of the shock wave and plasma generated by an 8J electric discharge, and visualization of projectiles in hypersonic flight. Author (ESRO)

N73-11472# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
NEW Nd YAG QUADRUPLET F(3/2) TO QUADRUPLET I(9/2)

LASER TRANSITIONS M.S. Thesis
Patrick James Pomphrey, Jr. Jun. 1972 9 p refs
(AD-746218; GEP/PH/72-15) Avail: NTIS CSCL 20/5

The objective was to study laser transitions in a pulsed Nd:YAG laser, end-pumped with the focused output of a high power, pulsed xenon-ion laser. The major efforts described include optimization of pump power, selection of dispersive elements for wavelength selection, prevention of laser damage to optical elements, identification and verification of new Nd:YAG laser wavelengths, measurement of 0.946 micrometer laser threshold as a function of temperature, and preliminary calculations of stimulated emission cross sections. Room temperature oscillations at 1.064, 0.946, 0.939, 0.900, 0.891, and 0.885 micrometer were obtained, the latter four being new Nd:YAG laser wavelengths. Author (GRA)

N73-11473# Bell and Howell Co., Pasadena, Calif. Electronic Materials Div.
DEVELOPMENT OF GaAs INFRARED WINDOW MATERIAL Final Technical Report, 1 Dec. 1969 - 30 May 1972
Alan G. Thompson Jul. 1972 64 p refs
(Contract N00014-70-C-0132; ARPA Order 306)
(AD-746500) Avail: NTIS CSCL 20/5

The choice of a window material suitable for high power CO2 lasers emitting at 10.6 microns is discussed. Gallium arsenide was chosen as the primary candidate with gallium antimonide being the object of a subsidiary investigation. The preparation of GaAs is discussed at length. The physical, electrical and optical properties of GaAs are also discussed with particular reference to the high-resistivity form which is necessary to reduce free-carrier absorption at 10.6 microns to an acceptable level. The method used to measure the optical absorption coefficient is a calorimetric one making use of a low power CO2 laser. The variation of the optical absorption coefficient with impurities, different dopants, resistivity, laser beam polarization and various growth parameters is examined. Techniques for preparing material in sizes considerably larger than prior state-of-the-art were developed. Author (GRA)

N73-11474# GTE Sylvania, Inc., Mountain View, Calif.
AMPLITUDE STABILIZED PULSED LASER Final Report, 29 Jun. 1970 - 29 Jun. 1972
William D. Fountain and Ronald L. Hansen 10 Jul. 1972 35 p refs
(Contract N00014-70-C-0342; ARPA Order 306)
(AD-746512; EOO-23) Avail: NTIS CSCL 20/5

The report summarizes the results during the reporting period of a program whose goal is the development of a flash-pumped, Q-switched, mode-locked, cavity-dumped, amplitude-stabilized laser operating at approximately 1.06 micrometer in the fundamental transverse (TEM(oo)) mode. System design and test results are presented. Author (GRA)

N73-11475# Massachusetts Inst. of Tech., Cambridge. Space Propulsion Lab.
RESEARCH ON MHD LASERS Annual Technical Progress Report, Jan. - Aug. 1971
Jack L. Kerrebrock Wright-Patterson AFB, Ohio AFAPL Mar. 1972 61 p refs
(Contract F33615-69-C-1226; AF Proj. 3145)
(AD-745986; AFAPL-TR-72-29) Avail: NTIS CSCL 20/5

A summary is presented of progress in a study of nonequilibrium generators, with emphasis on the vibrational excitation of molecular species. Experimental work on a large generator includes development of a coaxial preionizer and development of slanted electrode walls, both of which increase the power density of the generator. A pulsed analogue of an MHD laser has been constructed and operated providing data on the importance of CO2 dissociation in MHD lasers. A theoretical study of the interaction of electrothermal instabilities and the lasing radiation field has been made. It has been found that electrothermal instabilities grow faster in the presence of a lasing radiation field than without and that the electrothermal instabilities lead to extreme nonuniformity of the lasing radiation field. Author (GRA)

N73-11476# Williams Coll., Williamstown, Mass. Dept. of Physics.
NONLINEAR OPTICS OF METALS; FAR INFRARED LASERS Final Scientific Report
Fielding Brown Jun. 1972 7 p refs
(Grant AF-AFOSR-1284-67; AF Proj. 9764)
(AD-745984; AFOSR-72-1185TR) Avail: NTIS CSCL 20/5

The effect of adsorbed layers of gas on second harmonic light production by a silver surface has been studied experimentally, and the observed harmonic intensities have been found to be strongly adsorption dependent. Theories based on fundamental electronic properties of the metal are therefore inapplicable to generally employed experimental situations. In a related theoretical study, it has also been shown that difference frequency production via the ExH nonlinearity in semiconductors depends inversely on the square of the electron effective mass. This suggests that low effective mass semiconductors such as InSb may be efficient materials for difference frequency generation. A study of primary far infrared laser sources has been initiated as being preferable to sources requiring difference frequency generation. By pumping methyl fluoride gas with a 1 MW transversely excited CO2 laser a peak power of 10 watts has been achieved at 496 micrometers. Studies are planned to extend the power and usefulness of this and other far infrared lasers. Author (GRA)

N73-11477# Stanford Univ., Calif. Microwave Lab.
METHODS FOR OBTAINING LASER ACTION AT WAVELENGTHS SHORTER THAN 3000 A Final Report, 1 Jan. 1969 - 28 Feb. 1972
R. H. Pantell, H. Puthoff, D. L. Heckt, J. M. Yarborough, and W. R. Callen Jun. 1972 50 p refs
(Contract N00014-67-A-0112-0033; NR Proj. 016-107)
(AD-746174; SU-ML-2066) Avail: NTIS CSCL 20/5

The objective of this work is to obtain an ultraviolet source using Cerenkov radiation. Both the spontaneous and stimulated Cerenkov effects are studied theoretically and experimentally, to determine their feasibility as uv sources. From a classical analysis of the spontaneous Cerenkov effect a brightness formula is derived for a relativistic electron beam moving through a dielectric of finite thickness and suffering no collisions. The analysis is extended to include the effects of coulomb scattering from electron-atom collisions. The stimulated Cerenkov effect is analyzed classically from the Boltzmann and wave equations. The calculation follows the TWT (Traveling Wave Tube) analysis. From the analysis an experimental device was designed using a quartz Fabry-Perot resonator. Author (GRA)

N73-11478# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
ELECTRICAL HIGH-PRESSURE MOLECULAR GAS LASERS
E. J. Seppi May 1972 50 p refs
(Contract DAHC15-67-C-0011)
(AD-746148; P-847; IDA/HQ-72-14041) Avail: NTIS CSCL 20/5

The design and operation of high-power, electrically excited gas lasers are discussed with particular attention given to molecular-type lasers operating at high pressure. A survey is presented of gases in which laser action has been initiated by electrical discharge at high gas pressure. The basic processes for operation of the carbon-dioxide and carbon-monoxide lasers are described. The design criteria and the potential for high power and high brightness from a carbon-dioxide laser are discussed. The engineering requirements for a pumping arrangement which uses an electron beam for pre-ionization to obtain uniform electric pumping are reviewed. Author (GRA)

N73-11479# Northrop Corp., Hawthorne, Calif. Laser Systems Dept.
ABSORPTION MEASUREMENTS OF CARBON MONOXIDE LASER RADIATION BY WATER VAPOR
Dennis K. Rice Jul. 1972 38 p refs
(Contract N00014-72-C-0043; ARPA Order 1806; NR Proj. 016-303)
(AD-746170; NLSD-72-11R) Avail: NTIS CSCL 20/6

An intracavity water vapor cell in conjunction with a CO laser was used to experimentally measure the absorptive losses introduced for 19 of the laser emission lines. The results indicate that the existing theoretical models are inadequate for predicting actual absorptance values for water vapor partial pressures in

excess of 100 torr. The accepted spectral location of at least one water vapor absorption line was shown to be erroneous. A pressure broadening gas such as nitrogen was shown to increase the differential absorptive loss introduced by the water vapor for CO laser rotational lines. This result enhances the applicability of an intracavity water vapor cell as a device for limiting CO laser oscillation to lines having high atmospheric transmission.
Author (GRA)

N73-11480# Informatics, Inc., Rockville, Md.
BIBLIOGRAPHY OF SOVIET LASER DEVELOPMENTS Interim Report, Jan. - Mar. 1972
Stuart G. Hibben 17 May 1972 91 p refs
(Contract F44620-72-C-0053; ARPA Order 1622)
(AD-746339; AFOSR-72-1320TR; IR-7) Avail: NTIS CSCL 20/5

The report covers the first quarter of 1972 with the major yield of information coming from the approximately 30 periodicals known to report the most advanced and interesting findings in Soviet laser technology. This as well as the previous reports covers the following topics: (1) laser research--solid state, liquid, gas and chemical lasers; UV; components; nonlinear optics; spectroscopy of laser materials; short pulse generation; crystal growing; and general theory; (2) laser applications--biological effects, communications, computer technology, holography, instrumentation, materials processing, and plasma generation.
Author (GRA)

N73-11481# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
TEM SUB OO MODE ANALYSIS OF COMPLEX LASER CAVITIES M.S. Thesis
Glenn R. Doughty Mar. 1972 90 p refs
(AD-746215; GEP/PH/72-3) Avail: NTIS CSCL 20/5

A method of analyzing the dominant TEM(oo) mode of complex laser cavities is presented. The basic theory required for this analysis is summarized and extended to apply to cavities containing relatively short elements. This extension, accomplished by including third order expansion terms to describe short cavity elements, is specialized to cavities containing one plane mirror, one spherical mirror, an intra-cavity aperture, and a laser rod exhibiting a non-uniform gain distribution. The integral equation obtained by applying this theory is solved by the method of successive approximations. The computer program used to solve the integral equation for the TEM(oo) mode pattern, diffraction loss, and other cavity parameters is presented. Author (GRA)

N73-11482# Army Weapons Command, Rock Island, Ill. Weapons Lab.
REFLECTIVITY MEASUREMENTS WITH 10.6 MICROMETER INFRARED RADIATION
George E. VanDamme, M. J. Amoruso, and J. W. McGarvey Jun. 1972 29 p refs
(DA Proj. 1T0-61101-A-91A)
(AD-746238; SWERR-TR-72-39) Avail: NTIS CSCL 17/5

A reflectivity measurement technique using chopped 10.6 micrometer infrared radiation from a CO2 laser was developed under In-House Laboratory Independent Research Funding in the Research Directorate, Weapons Laboratory at Rock Island. The reflectivity of various target and environmental surfaces was determined with this technique. This technique was also used to determine the emissivity of a manganese-phosphate-coated barrel section; the results compared well with data obtained by more conventional methods. Author (GRA)

N73-11483# Aerospace Corp., El Segundo, Calif.
PROPAGATION OF FINITE CROSS-SECTION LASER BEAMS IN SEA WATER Technical Report, Apr. - May 1971
Hal T. Yura 30 Jun. 1972 32 p refs
(Contract F04701-71-C-0172)
(AD-745956; TR-0172(9230-10)-9; SAMSO-TR-72-167) Avail: NTIS CSCL 20/6

An expression is derived for mean irradiance distribution of a finite cross-section laser beam propagating in sea water. The effects of large-scale refractive variations on beam quality due to temperature and salinity fluctuations and the scattering of suspended biological particles with indices of refraction close to that of sea water are included. The analysis is general; it is valid in both the near and the far field of the laser transmitting aperture and also for an arbitrary complex disturbance in the exit pupil of the transmitting aperture. Analytic results are presented for the beam pattern and spot size of a Gaussian laser beam. Author (GRA)

N73-11484# Aerospace Corp., El Segundo, Calif.
SIMPLIFIED MODEL OF A CW DIFFUSION-TYPE CHEMICAL LASER Technical Report, Jan. 1971 - Jan. 1972
Harold Mirels, Robert Hofland, and William S. King 31 Mar. 1972 74 p refs
(Contract F04701-71-C-0172)
(AD-745952; TR-0172(2240-10)-5; SAMSO-TR-72-142) Avail: NTIS CSCL 20/5

A simplified analytical model of a diffusion-type HF chemical laser is presented. In this device, H2 is diffused into a supersonic stream to react with F atoms and form vibrationally excited HF that is made to lase. The reaction between H2 and F is assumed to commence at a flame sheet. A two-vibrational level model for the HF molecule is adopted. The dependence of laser amplifier and oscillator performance on diffusion rate, forward reaction rate, collisional deactivation rate, and radiative deactivation rate is determined. Author (GRA)

N73-11485# Naval Research Lab., Washington, D.C.
FLUORESCENCE AMPLIFICATION AND PARASITIC OSCILLATION LIMITATIONS IN DISC LASERS Final Report
John B. Trenholme Jul. 1972 70 p refs
(ARPA Order 2062)
(AD-747234; NRL-MR-2480) Avail: NTIS CSCL 20/5

In disc laser amplifiers, the achievable inversion (and thus the gain and energy output) is limited by fluorescence amplification and parasitic oscillaiton. In the paper, analytic results and Monte Carlo calculations of both these effects are presented for spheres, circular discs, and elliptical discs. The effects of gain, fluorescence line profile, refractive indices, and disc thickness on fluorescence amplification are presented. Parasitic oscillation is analyzed as a function of edge and face index ratios, and of edge roughening. The effects of both processes on peak inversion achieved during a pumping pulse are also presented. In conclusion, the maximum practical size of Nd(3-) glass laser discs is estimated to be about 30 cm due to the effects of parasitic oscillation and fluorescence amplification. Author (GRA)

N73-11486# Army Foreign Science and Technology Center, Charlottesville, Va.
HOLOGRAPHIC METHOD OF IMPROVING THE DIVERGENCE IN RADIATION OF THE RUBY LASER IN THE REGIME OF FREE GENERATION
M. D. Bondarenko, A. V. Gnatovskii, and M. S. Soskine 11 Feb. 1972 8 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 14, no. 11, Nov. 1969
(AD-746646; FSTC-HT-23-392-72) Avail: NTIS CSCL 14/5

To improve the divergence of OKG radiation the holographic method of transforming the coherence of light fields can be adopted based on the equality of interference beams. Correct radiation could be used for the creation of positive inverse coupling in the field and for the improvement of radiation laser characteristics. Author (GRA)

N73-11487# Rochester Univ., N.Y. Dept. of Physics and Astronomy.
ROCHESTER CONFERENCE ON COHERENCE AND QUANTUM OPTICS
Leonard Mandel and Emil Wolf 23 Jun. 1972 200 p refs Conf. held at Rochester, N. Y., 21-23 Jun. 1972
(Contract AF-AFOSR-2188-2; AF Proj. 9751)
(AD-746712; AFOSR-72-1387TR) Avail: NTIS CSCL 20/5

Synopsis of program: Resonant pulse propagation I; Quantum electrodynamics and alternative theories I; Coherence effects in spontaneous emission I; Coherence I; Quantum electrodynamics and alternative theories II; Light scattering I; Correlation and fluctuation measurements; Light scattering II; Coherence effects in spontaneous emission II; Coherent light interactions; Lasers; Quantum electrodynamics and alternative theories III; Resonant pulse propagation II; Coherence II; Coherence effects in spontaneous emission III; Post-deadline session; Quantum noise. GRA

N73-11488# University of Southern Calif., Los Angeles. Electronic Sciences Lab.
LASER SATURABLE RESONATORS AND CRITERIA FOR THEIR BISTABLE OPERATION Ph.D. Thesis
Joseph Winslow Austin Jan. 1972 142 p refs
(Grant AF-AFOSR-2066-71; AF Proj. 9751)
(AD-746736; AFOSR-72-1391TR; SR-8) Avail: NTIS CSCL 20/5

The theory for steady state operation of a saturable absorber was developed starting with the treatment of a Fabry-Perot interferometer with nonsaturable loss. Resonance characteristics of the interferometer were obtained in terms of mirror reflectivity and cavity loss. With this result it was then possible to replace the unsaturable loss with a saturable loss. In order to do this is was necessary to first develop models for the saturable absorbers used. A model with excited state absorption previously developed by Huff and DeShazer was extended to include both excited singlet and triplet level absorption. A second model, which was applicable to the semiconductor saturable absorber, was also developed. With a mathematical expression for the saturable absorber, it was possible to solve the saturable resonator problem. With this solution a set of criteria were established for operation of the saturable resonator in a bistable regime. Author (GRA)

N73-11489# National Bureau of Standards, Washington, D.C.
LASER DAMAGE IN MATERIALS Semiannual Report
Albert Feldman, Deane Horowitz, and Roy M. Waxler Jul. 1972 26 p refs
(ARPA Order 2016)
(AD-747290; NBS-10894; SAR-1) Avail: NTIS CSCL 20/5

The main objective of this program is the study of self-focusing in materials used in conjunction with high-energy laser systems. These studies are necessary because self-focusing is the main process which leads to bulk-intrinsic damage in laser materials. The damage appears as filamentary tracks in materials exposed to high-intensity laser radiation. Three mechanisms have been proposed to explain the effect: electrostriction, Kerr effect, and thermal self-focusing. Author (GRA)

N73-11490# Bendix Research Labs., Southfield, Mich.
SEISMIC HOLOGRAPHY FOR UNDERGROUND VIEWING Final Report, 30 Apr. 1971 - 31 May 1972
Ronald F. Steinberg and John B. Thuren Jul. 1972 143 p refs
(Contract BM-H0210032; ARPA Order 1579)
(AD-746498; RLD-6276) Avail: NTIS CSCL 08/7

The objective of this research program was to define a preliminary underground viewing system, based on acoustic holography principles, which is capable of detecting and imaging underground anomalies associated with a selected field test site. System requirements based on the geology of the selected site were specified and a proposed field test was designed. In addition, studies to develop a holographic weak signal enhancement technique were made. Author (GRA)

N73-11491# General Electric Co., Schenectady, N.Y.
OXIDE CERAMIC LASER Annual Technical Report, 1 Jun. 1971 - 31 May 1972
Charles D. Greskovich 24 Jul. 1972 61 p refs
(Contract N00014-70-C-0360; ARPA Order 1587)
(AD-746521; SRD-72-105) Avail: NTIS CSCL 20/5

Porosities as low as 0.000001 to 0.0000001 are attained in neodymuium-doped Yttralox (NDY) ceramics, provided that pore densities for large pores are low and that pore cluster formation is prevented during sintering. Large pores (about 50 micrometers) found in sintered material prepared from ball-milled powder originates from particles of mill-lining introduced into the powder batch during milling. The kinetics of removal of pores entrapped inside grains during the late stages of sintering are found to be related directly to the amount of grain growth. Grain growth during final stages of sintering of NDY material prepared from milled powder approximately follows as to the 1/3 power behavior, whereas grain growth approximately follows a t to the 1/2 power law in unmilled material at 2000C.
Author (GRA)

N73-11492# Army Foreign Science and Technology Center, Charlottesville, Va.
LASER LOCATING DEVICES
V. I. Petrovskii and O. A. Pozhidaev 21 Jun. 1972 91 p refs Transl. into ENGLISH from the Russian monograph
(AD-747003; FSTC-HT-23-943-71) Avail: NTIS CSCL 20/5

The authors describe the principles upon which laser locating devices operate. They describe the materials used as lasers, and the methods which can be employed to modulate the laser beam. They discuss the use of lasers in locating systems for determining range, angular coordinates and contour of a target object, and for tracking such objects after search has concluded. The examples of operating lasers which they cite specifically and the suggestions for future development of laser technology to which they refer are all taken from American publications.
Author (GRA)

N73-11595* Stanford Research Inst., Calif. Atmospheric Sciences Lab.
LIDAR PROBING OF THE ATMOSPHERE: SOME QUANTITATIVE ASPECTS
R. T. H. Collis and E. E. Uthe *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 9 p (For availability see N73-11585 02-19)
CSCL 20E

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N73-11493 National Lending Library for Science and Technology, Boston Spa (England).
BREAKDOWN OF CONTINUITY IN METALS AND ALLOYS DURING THE PROCESS OF PLASTIC DEFORMATION
G. Lepin, V. M. Nesterenko, A. P. Tikhonov, and V. F. Gorpinich Oct. 1972 11 p refs Transl. into ENGLISH from Mashinostr. (Kiev), no. 7, 1970 p 57-62
(NLL-RTS-7426) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.10; 4 NLL photocopy coupons

The mechanics of vulnerability in metals and alloys during plastic deformation at temperatures between 100 and 300 C are investigated. Data were graphed to depict the relationship between vulnerability factor and temperature. E.H.W.

N73-11494 National Lending Library for Science and Technology, Boston Spa (England).
FATIGUE STRENGTH OF PRE-STRAINED STEEL
N. I. Chernyak 19 Jun. 1972 19 p refs Transl. into ENGLISH from Sb. Tr. Inst. Stroit. Mekh. (USSR), no. 18, 1953 p 103-115 (NLL-SMRE-Trans-5862-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

A method is presented for measuring plastic deformation and demonstrating the influence of preliminary tensile strain on the fatigue strength of 45 and 40Kh steel. The method examines the fatigue properties of steel depending on the degree of uniform work hardening brought about by tensile loading. The problem as posed excludes consideration of the influence of residual stress of the first order and the nonuniformity of mechanical properties due to changes in section. Author

N73-11495 National Lending Library for Science and Technology, Boston Spa (England).
IMPROVEMENT OF NICKEL CALCIUM ALLOYS
L. I. Levi and V. E. Balabankin 18 Jul. 1972 8 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Tsvet. Met. (Dzaudzhikau), no. 1, 1972 p 109-111 In RUSSIAN and ENGLISH
(NLL-Trans-746-1347-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Techniques for improving the quality of nickel cadmium alloys by removing carbon and oxygen are described. Calculations and experiments indicate the impossibility of deoxidizing nickel by

dissociation of nickel oxide in vacuum induction furnaces. A method of deoxidizing nickel alloys by blowing hydrogen onto the bath surface with continuous evacuation of gases from the furnace chamber was investigated. Author

N73-11496 National Lending Library for Science and Technology, Boston Spa (England).
HARD TITANIUM CARBIDE CASE COMPOSITE ALLOYS
G. V. Samsonov, N. N. Sergeev et al 18 Jul. 1972 8 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), no. 9, 1971 p 42-45 In ENGLISH and RUSSIAN (NLL-Trans-746-1226-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Conditions for obtaining hard titanium carbide base alloys with a nickel filler were investigated. It was shown that an alloy with 80% TiC-20% Ni, obtained from finely ground mixtures by sintering in a vacuum of 0.005 mm mercury at 1300 C and isothermal holding for 30 minutes, possesses satisfactory mechanical properties. The wear resistance of the alloys tested is 1.6 to 1.8 times better than that of the standard T14K8 alloys during cutting of steel at a rate of 120 to 180 m/min, and is 1.5 to 2 times better than that of the VK6 alloys when they are used as dies for wire drawing. Author

N73-11497 National Lending Library for Science and Technology, Boston Spa (England).
THE INFLUENCE OF HYDROSTATIC PRESSURE ON THE PLASTICITY OF ALPHA AND BETA BRASS
B. I. Bershev and Yu. I. Ryabinin 10 Jul. 1972 7 p refs Transl. into ENGLISH from Fiz. Metal. i Metalloved. (USSR), no. 32, 1971 p 216-217 In RUSSIAN and ENGLISH (NLL-NEL-TT-2398-(6075.461)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The influence of hydrostatic pressure on the plasticity of two phase brass as determined by changes in their stability is investigated. E.H.W.

N73-11498 National Lending Library for Science and Technology, Boston Spa (England).
CONFERENCE ON PROPERTIES OF HEAT RESISTANT STEELS
W. Siegreid 10 Jul. 1972 32 p refs Transl. into ENGLISH of the publ. "Neue Meoglichkeiten der ermittlung von Zusamenhaengen zwischen der Form der Zeitstandkurven und Strukturveraenderungen durch Anwendung der exponentiellen funktion realer Ordnung" Geneva, 1972 In ENGLISH and GERMAN Conf. held at Dusseldorf, 3-5 May 1972
(NLL-NEL-TT-2404-(6075.461)) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

Methods for determining the relationships between the shapes of creep curves and changes in structure by applying the exponential function of real order are described. Two approaches are proposed. In one a model is set up to show how the combined effects of the elements of the mechanisms are to be regarded in their main lines and what is required of them to work out the influences of the various factors on the time to rupture. In the second method the combined effects of the various mechanisms are determined by evaluating investigations that have been made on changes in structure with the passage of time. The parameters which comprise the model and its method of construction are explained. Author

N73-11499 National Lending Library for Science and Technology, Boston Spa (England).
RESEARCH INTO THE MAGNETIC PROPERTIES OF ALLOYS CONTAINING RARE EARTH ELEMENTS
B. S. Vekshin, A. A. Volskii, V. P. Dmitriev, G. Kh. Enikeev, B. A. Kapitanov, V. S. Kraposhin, B. G. Livshits, Ya. L. Linetskii, Yu. I. Milyavskii, V. L. Pashkova et al [1972] 9 p refs In ENGLISH and RUSSIAN
(NLL-M-21478-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The magnetic properties and microstructures of cobalt alloys containing 30 to 35 percent samarium have been analyzed. Powered specimens were used for measuring saturation magnetization, residual magnetization, and coercive forces. In the case of all alloys, lengthening the milling time in a vibro-mill was accompanied by a steady increase in the coercive force and the hysteresis loop became less convex. Increasing the amount of samarium was found to cause a steady increase in the coercive force and the convexity of the hysteresis loop, together with a drop in the saturation magnetization. Author

N73-11500 National Lending Library for Science and Technology, Boston Spa (England).
EFFECT OF HEAT RESISTANT COATINGS ON FATIGUE LIFE OF HEAT RESISTANT ALLOY
I. I. Ishchenko, V. I. Omelchenko et al 18 Jul. 1972 15 p refs Transl. into ENGLISH from Probl. Prochnosti v Mashinostr., Akad. Nauk SSSR, Inst. Mashinoved. (Moscow), no. 10, 1971 p 76-81 In RUSSIAN; ENGLISH summary
(NLL-746-1236-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The effects of heat resitant coatings on the fatigue life of the nickel base ZhS6K alloy are discussed. Fatigue tests were conducted on the alloy at 950 C under conditions of pure bending with rotation during a symmetrical loading cycle. It is concluded that the decrease in the fatigue life of samples of the alloy after long term soaking at an elevated temperature is induced by two processes: (1) the structural and phase changes in the basic material and (2) the active oxidation of the surface of the samples. Author

N73-11501 National Lending Library for Science and Technology, Boston Spa (England).
STRUCTURAL CHANGES IN SUPERPLASTIC Cr-Ni-Fe ALLOYS DURING HIGH-TEMPERATURE ELONGATION
F. D. Glebova, A. N. Kurasov et al 18 Jul. 1972 5 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 8, 1971 p 133-136 In ENGLISH and RUSSIAN
(NLL-Trans-746-1153-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The structural changes during elongation of two-phase, high chromium, Cr-Ni-Fe alloys, showing superplasticity of a wide range of temperature and concentration have been investigated. The mechanism of superplasticity is applied to the selection of conditions for hot deformation. Samples with a working length of 15 millimeters and a diameter of 3 millimeters were elongated at a rate of 1.5 millimeters per minute at 600 to 1,250 C after 15 minutes of preliminary holding under these temperature conditions. Data on the relative elongation of the samples depending on the test temperature of the alloy are presented. The microstructure of the deformed samples was examined on longitudinal sections. The development of phase transformations during heating is described. Author

N73-11502 National Lending Library for Science and Technology, Boston Spa (England).
APPLICATION OF X-RAY-SPECTRAL ANALYSIS DURING CORROSION INVESTIGATIONS
V. V. Dobrolyubov, V. G. Dubinin et al 18 Jul. 1972 9 p ref Transl. into ENGLISH from Zashch. Metal. (Moscow), no. 6, 1971 p 705-708 In ENGLISH and FRENCH
(NLL-Trans-746-1218-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon CSCL 07D

The application of X-ray spectral analysis for investigating corrosion in metal samples is discussed. The procedure is based on irradiating the sample with the primary emission from an X-ray tune and analyzing the secondary X-ray emission from the sample with an X-ray spectrometer. Crystals of lithium fluoride and pentaeritrite were used as the crystal analyzers. The pentaeritrite was used when it was necessary to measure the X-ray emission from light elements, such as sulfur, phosphorus, and silicon. The intensity of the X-ray lines was registered both automatically on paper from the recording instrument and by calculating the impulses. Author

N73-11503 National Lending Library for Science and Technology, Boston Spa (England).
ALUMINIZING OF TITANIUM AND VT-14 ALLOY IN POWDERS USING ELECTRIC HEATING
I. N. Kidin et al [1972] 13 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 5, 1972 p 139-142 In ENGLISH and RUSSIAN
(NLL-M-21479-(5828.4F)) Avail: Natl. Lending Library, Boston,

Spa, Engl.: 1 NLL photocopy coupon
The aluminizing of titanium and VT-14 alloy in powders using electric heating methods is discussed. The structure and phase composition of diffusion layers and their aluminum content have been studied using metallographic, electron probe, and x-ray phase analysis, together with measurements of microhardness and microthermo-electomotive force. Diffusion layers 50 to 100 microns deep can be obtained in five to ten minutes. The use of electric heating accelerates the aluminizing of VT 1-0 grade titanium and VT 14 alloy. An increase in the electric heating rate results in the formation of deeper diffusion layers. Author

N73-11504 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATION OF STRENGTHENING IN STEEL USING A PLANNED EXPERIMENTAL METHOD
P. I. Polukhin et al [1972] 11 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chern. Met. (Moscow), no. 5, 1972 p 143-146
(NLL-M-21480-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A study was made of the influence of hot plastic deformation schedules in high temperature thermomechanical treatment on the properties of Kh18N10T using a planned experimental method. Equations were obtained for the dependance of mechanical properties on the parameters investigated. The deformation rate was of major influence on the steel's properties after hot rolling. After rolling with high temperature thermomechanical treatment and subsequent tempering at 500 C for 2 h, the tensile properties improved although ductile properties decreased slightly.
Author

N73-11505 National Lending Library for Science and Technology, Boston Spa (England).
SUPER CONDUCTIVITY IN HIGH PRESSURE METAL PHASES
Tetsu Nakajima 23 Jul. 1972 10 p refs Transl. into ENGLISH from Nippon Kinzoku Gakkai Kaiho (Japan), v. 10, no. 6, 1971 p 392-397
(NLL-NEL-TT-2402-(6075.461)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The production of superconductivity under high pressure in materials whose superconductivity under normal pressure is unknown is discussed. The process is applied to understanding the mechanism of superconductivity phenomena in metals and its universality from conditions for the production of superconductivity. An analysis of the elements in the periodic table with respect to their superconductivity properties is described. The conditions which are required to produce superconductivity in high pressure metal phases are presented in chart form. The relationship between superconductivity in high pressure metal phases and semiconductor-metal transition is considered.
Author

N73-11506# Aeronautical Research Labs., Melbourne (Australia).
OPERATOR EFFECTS IN NDI. PART 1: EDDY CURRENT MEASUREMENTS ON ALUMINUM ALLOY BLOCKS CONTAINING EDGE SLOTS
H. R. Chin Quan and I. G. Scott Apr. 1972 27 p refs
(ARL/MET-Note-82-Pt-1; ISBN-642-97736-4) Avail: NTIS HC $3.50

Optical measurements were made on thin slots milled in the edges of aluminum alloy test blocks. The slots were covered and a number of operators used eddy current equipment to determine the presence and size of the slots. A fixed frequency (4 MHz) commercial eddy current instrument with a standard flat probe was used. A radiograph of the probe was conducted. The experimental procedure involved measurement of slot indications, slot detectability by various operators, and slot measurement by various operators. Results are presented in tables and graphs.
Author

N73-11507# Technische Universitaet, Brunswick (West Germany). Fakultaet fuer Maschinenbau und Elektrotechnik.
CALCULATION OF STRESS RELAXATION CURVES IN METALS FROM THEIR CREEP DIAGRAMS Ph.D. Thesis [BERECHNUNG DER SPANNUNGSRELAXATIONSKURVEN VON METALLEN AUS IHREN KRIECHKURVEN]
Abdul Karim Hammami 20 Aug. 1971 82 p refs In GERMAN
Avail: NTIS HC $6.25

Creep curves from a number of metals and temperatures are used to calculate stress relaxation properties. Good agreement between theory and experiment is observed for the case where the degree of deformation is the independent variable in a high temperature environment; if time is the independent variable, only the beginning of the relaxation curve agrees with measurements. Calculations fail when applied to heat resistant steels at temperatures below 450 C.
Transl. by G.G.

N73-11508# Research Inst. of National Defence, Stockholm (Sweden). Dept. 4.
STUDIES AND INVESTIGATIONS OF URANIUM ALLOYS FROM THE LITERATURE
Mats Liljas Aug. 1971 45 p refs In SWEDISH
(FOA-4-C-4471-D4) Avail: NTIS HC $4.25

The metallurgical, physical and mechanical properties of uranium alloys have been studied in an examination of the literature. The object was to discover a material with high breakdown strain and ultimate elongation combined with high density. Based on the study of literature, 27 different uranium alloys were selected for a metallographic examination, and as a result four of the alloys have been chosen as the most suitable with respect to the above stated objectives.
Author

N73-11509*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A MECHANICAL PROPERTY AND STRESS CORROSION EVALUATION OF CUSTOM 455 STAINLESS STEEL ALLOY
J. W. Montano 2 Aug. 1972 60 p ref
(NASA-TM-X-64682) Avail: NTIS HC $5.00 CSCL 11F

The mechanical and stress corrosion properties are presented of vacuum melted Custom 455 stainless steel alloy bar (1.0-inch diameter) and sheet (0.083-inch thick) material aged at 950 F, 1000 F, and 1050 F. Low temperature mechanical properties were determined at temperatures of 80 F, 0 F, -100 F, and -200 F. For all three aging treatments, the ultimate tensile and 0.2 percent offset yield strengths increased with decreasing test temperatures while the elongation held fairly constant down to -100 F and decreased at -200 F. Reduction in area decreased moderately with decreasing temperature for the longitudinal round (0.250-inch diameter) specimens. Notched tensile strength and charpy V-notched impact strength decreased with decreasing test temperature. For all three aging treatments, no failures were observed in the unstressed specimens or the specimens stressed to 50, 75, and 100 percent of their yield strengths for 180 days of alternate immersion testing in a 3.5 percent NaCl solution. As indicated by the results of tensile tests performed after alternate immersion testing, the mechanical properties of Custom 455 alloy were not affected by stress or exposure under the conditions of the evaluation.
Author

N73-11510*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE EFFECT OF HOT SALT ON THE MECHANICAL PROPERTIES OF SEVERAL SUPERALLOYS
Eli E. Nelson 19 Oct. 1972 23 p refs
(NASA-TM-X-64701) Avail: NTIS HC $3.25 CSCL 07D

The effect of sodium chloride on unstressed, transverse, tensile metal specimens at elevated temperatures was determined. Results indicate that the mechanical properties of Inconel 718, Rene 41, titanium base alloy 13V-11Cr-3Al, Hastelloy X, HS25 (L605), HS188, and TD NiCr suffer degradation in tensile strength and ductility due to hot salt exposure.
Author

N73-11511# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
STANDARD REFERENCE MATERIALS: PREPARATION AND HOMOGENEITY CHARACTERIZATION OF AN AUSTENITE IRON-CHROMIUM-NICKEL ALLOY
Harvey Yakowitz, Arthur W. Ruff, and Robert E. Michaelis Nov. 1972 20 p refs
(NBS-SP-260-43; LC-72-600312) Avail: SOD $0.45 as C 13.10:260-43

An alloy of weight fraction 0.710 iron, 0.183 chromium and 0.107 nickel was characterized at the micrometer level of spatial resolution by means of electron probe microanalysis. This

alloy, designated SRM 479, is of suitable homogeneity for use as a standard in microanalytical techniques. The coefficient of variation for each of the three elements is not more than 1.5 percent based on about 800 analyses involving five different specimens. There is no statistically significant variation in composition within specimens or from specimen to specimen. Electron probe microanalysis was carried out using different instrumental conditions and operators. SRM 479 is supplied as a disk about 4.6mm diameter by 1mm thick. Author

N73-11512*# Fansteel, Inc., Baltimore, Md. Metals Div.
DEVELOPMENT OF DISPERSION STRENGTHENED NICKEL-CHROMIUM ALLOY (Ni-Cr-Th-O2) SHEET FOR SPACE SHUTTLE VEHICLES, PART 1 Final Report
L. J. Klingler, W. R Weinberger, P. G. Bailey, and S. Baranow 30 Dec. 1971 493 p
(Contract NAS3-13490)
(NASA-CR-120796) Avail: NTIS HC $26.75 CSCL 11F

A dispersion-strengthened alloy, TD nickel chromium (TDNiCr) is being developed for use on the thermal protection system of the space shuttle at temperatures up to 1204 C(2200 F). Manufacturing processes were developed for the fabrication of sheet and foil to specifications. The addition of aluminum to the basic TDNiCr composition provides outstanding oxidation resistance up to 1260 C(2300 F); aluminum levels of 2 to 4% are considered optimum for space shuttle application. Author

N73-11513# National Aerospace Lab., Amsterdam (Netherlands).
ELECTRON FRACTOGRAPHY OF CLEAVAGE
D. Broek Apr. 1971 31 p refs Sponsored by the Directorate of Mater., Air, RNLAF
(NLR-TR-71047-U) Avail: NTIS HC $3.75

The significant fractographic features of cleavage are detailed. The topography of cleavage tongues was determined from stereographic measurements. These measurements prove that cleavage tongues are formed at twins and that two types of cleavage tongues can be distinguished. Twins can also generate steps in the fracture surface. Author (ESRO)

N73-11514# National Aerospace Lab., Amsterdam (Netherlands).
ELECTRON FRACTOGRAPHY OF FATIGUE IN VACUUM
D. Broek, A. Hartman, and A. Nederveen Mar. 1971 15 p refs
(NLR-TR-71032-U) Avail: NTIS HC $3.00

A few preliminary tests on 2024-T3 material were carried out allowing electron fractographical examination of the features of fatigue crack growth in vacuum. Fatigue striations were generally not formed in vacuum. The fracture surface consists of irregular fine slip steps and coarse slip steps which show periodicity. Author (ESRO)

N73-11515# British Steel Corp., London (England). Metallurgy Dept.
INTERACTIONS BETWEEN RESIDUAL ELEMENTS, INCLUSIONS, TOUGHNESS AND STRESS CORROSION RESISTANCE IN A HIGH STRENGTH STEEL
A. H. Priest Apr. 1972 17 p refs
(PB-209655; MG/6/71) Avail: NTIS HC $3.00 CSCL 11F

Variations in fracture toughness and stress corrosion resistance of a martensitic Ni-Cr-Mo-V steel were attributable to differences in the levels of carbon, phosphorus and sulphur. The residual elements, As, Cu, Sb and Sn had no significant effect on these properties even after tempering between 400 C and 600 C for extended periods of time. Author (GRA)

N73-11516# Naval Ordnance Lab., White Oak, Md.
ON THE TiNi (NITINOL) MARTENSITIC TRANSITION, PART 1
Frederick E. Wang 1 Jan. 1972 8 p refs
(AD-742767; NOLTR-72-4-Pt-1) Avail: NTIS CSCL 11/6

The experimental evidence obtained and the theory proposed thus far on the TiNi martensitic transition are summarized and reviewed. Fundamental principles involved in the various modes of investigation are described and the uniqueness of the transition is detailed. Author (GRA)

N73-11517# Naval Research Lab., Washington, D.C.
A PROCEDURE FOR INVESTIGATING THE EFFECT OF HYDROGEN CONTENT ON TOUGHNESS AND SUSTAINED LOAD CRACKING RESISTANCE OF TITANIUM ALLOYS, WITH SOME RESULTS FOR Ti-6Al-4V
Dale A. Meyn Jun. 1972 21 p refs
(WR0220101)
(AD-746443; NRL-MR-2461) Avail: NTIS CSCL 11/6

A procedure for measuring the effect of hydrogen content on the toughness and resistance to sustained load crack (SLC) growth of titanium alloys is presented. The results of such measurements on a high oxygen content, very high yield strength heat of 1-in. thick Ti-6Al-4V alloy (R-23B) are compared with results for a low oxygen content, moderately high yield strength heat (R-14). Both fracture toughness and SLC resistance of R-23B are greatly reduced by small amounts (35 ppm) of hydrogen added to vacuum annealed specimens. The fracture toughness, but not SLC resistance, of R-14 was likewise affected, in the hydrogen content range from 9 ppm to 125 ppm. The substantial gain in toughness due to vacuum annealing a commercial heat of Ti-6Al-4V (R-23B), without reduction in hardness, raises the possibility of developing a vacuum annealing schedule for greatly increasing the reliability of critical high strength structural parts. Author (GRA)

N73-11518# Battelle Columbus Labs., Ohio.
METALLURGICAL CONTROL OF FATIGUE CRACK GROWTH IN HIGH-STRENGTH ALUMINUM ALLOYS Final Report, 1 Jan. - 30 Dec. 1971
G. T. Hahn and R. Simon Wright-Patterson AFB, Ohio AFML May 1972 33 p refs
(Contract F33615-71-C-1107; AF Proj. 7351)
(AD-745989; AFML-TR-72-48) Avail: NTIS CSCL 11/6

The results of 22 different investigations of cyclic crack growth, principally on the 2024-T3 and 7075-T6 alloys, but including results for unalloyed and other 2-, 5-, 6-, and 7-thousand series alloys, were examined and compiled with a view to separating metallurgical effects from other factors. The various crack growth measurements show good agreement when the comparisons involve the same R-value, environment and cyclic frequency. Both the 2024-T3 and 7075-T6 alloy can display widely different rates of growth for the same delta K-value. Crack growth rate-delta K measurements have also been converted into S-N curves for cracked members. These curves illustrate the influence of flaw size, stress range, R and K sub c on the cyclic life of the 7075-T6 and 2024-T3 grades. GRA

N73-11519# George Washington Univ., Washington, D.C. Inst. for the Study of Fatigue Fracture and Structural Reliability.
FOUR BASIC TYPES OF METAL FATIGUE
William A. Wood Jun. 1972 99 p refs
(Contract N00014-67-A-0214-0011)
(AD-746121; TR-10) Avail: NTIS CSCL 11/6

Confusion at present existing in the literature about how fatigue cracks originate and grow can be resolved by distinguishing between four basic types of fatigue, each with a distinctive mode of crack initiation and growth. Each type is illustrated by scanning electron microscopy. Author (GRA)

N73-11520# George Washington Univ., Washington, D.C. Inst. for the Study of Fatigue, Fracture and Structural Reliability.
SOME FRACTURE MODES IN METAL FATIGUE
Charles M. Gilmore, Douglas E. MacDonald, and William A. Wood Jul. 1972 23 p refs
(Contract N00014-67-A-0124-0011)
(AD-746125; TR-12) Avail: NTIS CSCL 11/6

The report describes scanning electron-microscope studies made in an attempt to resolve current confusion in the literature about how fatigue cracks begin. It has been said that they normally grow by a Stage I process of shear, on the grounds that they form along slip bands, which are known to tend to directions of maximum shear. It is found that in fact cracks started by slip do not necessarily follow the Stage I shear rule, but may follow random paths and that optimum condition for Stage I cracking is indeed absence of slip. Further, it is shown that much of the confusion disappears if a distinction is made between plastic metals, in which cracking in particular conditions can be started by slip, and elastic metals in which cracking is

started rather by local inhomogeneous strains and internal stresses and may have little to do with slip. Author (GRA)

N73-11521# George Washington Univ., Washington, D.C. Inst. for the Study of Fatigue, Fracture and Structural Reliability.
FATIGUE AND FRACTURE MECHANICS
Alfred M. Freudenthal May 1972 34 p refs
(Contract N00014-67-A-0214-0011)
(AD-746122; TR-11) Avail: NTIS CSCL 11/6

The application of methods of fracture mechanics to the prediction of fatigue life presupposes the existence of a single flaw of critical size the slow propagation of which, under repeated cyclic loading, represents the relevant damage mechanism that governs fatigue until the flaw has grown to unstable size. The conditions under which this approach to fatigue provides a reasonable model of real behavior are, however, exactly the conditions that should be avoided by adequate fatigue design. Thus the merit of fracture mechanics with respect to fatigue is not in the realistic modeling of the fatigue process in its various aspects, but in the delimitation of the conditions under which this process approaches the model too closely for purposes of design. The paper discusses the different aspects of the fatigue process in relation to the basic concepts of fracture mechanics. Author (GRA)

N73-11522# Army Electronics Command, Fort Monmouth, N.J.
ELECTROLYTIC PREPARATION AND EVALUATION OF TUNGSTEN BRONZES
John A. Christopulos Jun. 1972 23 p refs
(DA Proj. 1T6-62705-A-053)
(AD-746248; ECOM-3586) Avail: NTIS CSCL 11/6

Mixed sodium-iron tungsten bronzes were electrolytically prepared from melts of tungstic oxide, sodium tungstate, and ferrous tungstate. The corrosion rate in 1F KOH appeared to be directly proportional to the oxygen partial pressure. Results of galvanostatic steady-state experiments for oxygen electroreduction in acid solutions are in agreement with existing knowledge that the rate determining step (r.d.s) is a charge transfer step. In KOH, r.d.s is not a simple charge transfer but some other process. Author (GRA)

N73-11523# Brown Univ., Providence, R.I. Engineering Materials Research Lab.
SUBSEQUENT YIELD SURFACES FOR ANNEALED MILD STEEL UNDER DEAD-WEIGHT LOADING: AGING, NORMALITY, CONVEXITY, CORNERS, BAUSCHINGER AND CROSS EFFECTS.
Michael J. Michno, Jr. and William N. Findley May 1972 38 p refs
(Contract N00014-67-A-0191-0003; NR Proj. 064-424)
(AD-746474; EMRL-48; TR-18) Avail: NTIS CSCL 11/6

Subsequent yield curves covering all four quadrants of axial stress-shear stress space were experimentally determined for SAE 1017 steel. Initial-yield test results for six different specimens under various combinations of axial load and twisting moments for dead-weight loading exhibited too much scatter to provide a definitive surface. However, after initial yielding of one to five percent a family of small-offset multiple probe yield curves was determined for each specimen. Subsequent curves in a given family of curves were derived from the preceding curves by either strain aging or loadings into the plastic range. Plastic strain increment vectors for zig-zag loading paths were determined. Author (GRA)

N73-11524# Brown Univ., Providence, R.I. Engineering Materials Research Lab.
AN HISTORICAL PERSPECTIVE OF YIELD SURFACE INVESTIGATIONS FOR METALS
Michael J. Michno, Jr. and William N. Findley Apr. 1972 55 p refs
(Contract N00014-67-A-0191-0003; NR Proj. 064-424)
(AD-746473; EMRL-47; TR-17) Avail: NTIS CSCL 11/6

The survey reviews work dealing either directly or indirectly with initial and subsequent yield surfaces. Emphasis is placed primarily on experimental investigations. Features of the work surveyed which are discussed include motivation, discrepancies, attempts to overcome discrepancies, and the nature of further work needed. Author (GRA)

N73-11525# Brown Univ., Providence, R.I.
EXPERIMENTS TO DETERMINE SMALL OFFSET YIELD SURFACE FOR 304L STAINLESS STEEL UNDER COMBINED TENSION AND TORSION
Michael J. Michno, Jr. and William N. Findley Apr. 1972 32 p refs
(Contract N00014-67-A-0191-0003; NR Proj. 064-424)
(AD-746472; EMRL-49; TR-16) Avail: NTIS CSCL 11/6

The highly strain-hardening nature of 304L stainless steel, coupled with hardening due to a stress-induced martensitic transformation, caused considerable difficulty in determination of yield curves by a multiple-probe small-offset technique. Small probes of added shearing stress appeared to cause considerably more accumulated strain-hardening damage to a yield curve than small probes of added tensile stress. When a portion of a yield curve could be defined it appeared to be convex, and the plastic strain increment vector was normal in agreement with the stability postulate. Some evidence to support corner formation on a yield curve due to the disturbance of probing is presented. The exact nature of corners is indeterminant. An extreme Bauschinger effect for surprisingly small prestrains was observed in both tension and torsion. Author (GRA)

N73-11526# Army Foreign Science and Technology Center, Charlottesville, Va.
PORTION OF Mg-Y-Zn PHASE DIAGRAM RICH IN MAGNESIUM
B. N. Zaselyan 11 Feb. 1972 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Metal. (Moscow), no. 6, 1968
(AD-746724; FSTC-HT-23-491-70) Avail: NTIS CSCL 11/6

A study was made of the ternary diagram of magnesium-yttrium-zinc in the region rich in magnesium. All the alloys were analyzed to determine the yttrium, zinc, and magnesium content, in accordance with a procedure based on preliminary separation of the zinc. The ternary solid solution of the magnesium-yttrium-zinc system has a lower concentration than do binary solid solutions based on magnesium. Author (GRA)

N73-11527# Army Foreign Science and Technology Center, Charlottesville, Va.
EXPERIMENTAL INVESTIGATION OF THE PRINCIPLES OF DEFORMATION OF CARBON STEEL UNDER CONDITIONS OF COMPLEX STRESS STATE AT LOW TEMPERATURES
G. S. Pisarenko, A. A. Lebedev, and V. P. Lamashevskiy 3 Apr. 1972 14 p refs Transl. into ENGLISH from Probl. Prochnosti v Mashinostr., Akad. Nauk SSSR, Inst. Mashinoved. (Moscow), no. 5, 1969 p 42-47
(AD-746723; FSTC-HT-23-377-72) Avail: NTIS CSCL 11/6

The work is an attempt at experimental checking of hypotheses on the relation between stresses and deformations for nonlinear-elastic and elasto-plastic media. Qualitative analysis of deformation curves is given. The character of hardening of carbon steel with decreasing temperature depends on the form of stress state. The condition of similarity of deviators at low temperatures is violated for the investigated steel. Author (GRA)

N73-11528# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
FOURIER PATTERN RECOGNITION TECHNIQUES APPLIED TO TITANIUM ALLOY PHOTOMICROGRAPHS M.S. Thesis
Graham L. Perry May 1972 77 p refs
(AD-746720; GA/EE/72-2) Avail: NTIS CSCL 11/6

The properties of the Fourier Transforms of titanium alloy photomicrographs are investigated. The characteristics of the discrete Fourier Transforms are outlined, and the principles of pattern recognition by spatial filtering and matched filter correlation are discussed. The technique of data preparation is described, and the results from both spatial filtering and correlation methods are presented and discussed. The conclusion is reached that texture patterns such as metal microstructure are too noisy for successful pattern recognition by spatial filtering, but matched filter correlation techniques show some promise for accurate measurement of defined object populations in noisy samples. Author (GRA)

N73-11529# Watervliet Arsenal, N.Y.
DIFFUSION IN A CUBIC METAL CONTAINING INTERSTITIAL IMPURITIES

Clarke G. Homan Jun. 1972 39 p refs
(DA Proj. 1T0-61102-B-32-A)
(AD-746949; WVT-7214) Avail: NTIS CSCL 11/6

Theoretical expressions are derived for the atomic fluxes in a cubic interstitial impurity alloy system which includes the possibility of interstitial impurity atom-vacancy interactions. These results are used to obtain expressions for the self and interstitial impurity diffusion coefficients. The equations are extended further to obtain the bulk and interstitial Soret coefficients associated with atom movements in a temperature gradient. The theoretical results are compared with reported experimental data.
Author (GRA)

N73-11530# Watervliet Arsenal, N.Y.
EFFECTS OF NONMETALLIC INCLUSIONS ON STAGE 2 FATIGUE CRACK PROPAGATION IN A LOW ALLOY STEEL M.S. Thesis
Peter A. Thornton May 1972 105 p refs
(AD-746950; WVT-7215) Avail: NTIS CSCL 11/6

The dependence of fatigue crack growth rate on stress intensity factor range was shown to be more sensitive to the morphology and distribution of inclusions than to the total quantity of nonmetallistics present. Higher crack growth rates were obtained in specimens containing relatively small sulphides that were irregularly shaped and clustered or aligned. Conversely, the lowest crack growth rates were obtained in specimens containing well distributed, spherical oxides. Fractographic examination accompanied by energy dispersive x-ray analysis of inclusions in situ on fracture surfaces illustrated the involvement of inclusions in the fracture process. Also, these inspections verified the metallographic observations. Author (GRA)

N73-11531# Failure Analysis Associates, Stanford, Calif.
IMPROVED FRACTURE TOUGHNESS OF Ti-6Al-4V THROUGH CONTROLLED DIFFUSION BONDING Final Report, Nov. 1970 - Nov. 1971
Donald O. Cox and Alan S. Tetelman Wright-Patterson AFB, Ohio AFML Feb. 1972 84 p refs
(Contract F33615-71-C-1062; AF Proj. 7381)
(AD-746765; AFML-TR-71-264; Rept-5-829) Avail: NTIS CSCL 11/6

The report presents the results of work done in evaluating the mechanical properties of 6Al-4V titanium multi-laminate materials for possible application to Air Force systems. GRA

N73-11532# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONSTITUTIONAL DIAGRAMS OF METAL SYSTEMS
A. P. Alisova and P. B. Budberg 12 May 1972 632 p refs
Transl. into ENGLISH of the book "Diagrammy Sostoyaniya Metallicheskikh Sistem" Moscow, Prozvodstvenno-Izdatelskiy Kombinet Viniti, no. 13, 1970 p 1-277
(AF Proj. 7351)
(AD-746792; FTD-MT-24-1448-71) Avail: NTIS CSCL 11/6

The report presents phase diagrams of various alloys. Literature sources containing results of investigations of crystalline structures, physical and chemical properties and other phase characteristics are included. Phase diagrams of metals with non-metallic elements are given only if the study of diagrams began with 100 percent of the metallic element. GRA

N73-11533# Naval Research Lab., Washington, D.C.
A CHARACTERIZATION OF THE FRACTURE RESISTANCE OF THICK-SECTION TITANIUM ALLOYS Final Report
R. W. Judy, Jr., C. N. Freed, and R. J. Goode 5 Jul. 1972 16 p refs
(NRL Proj. M01-24)
(AD-747230; NRL-7427) Avail: NTIS CSCL 11/6

Procedures for design of structures to preclude catastrophic fracture extension must be based on accurate fracture resistance characterizations of the structural material that can only be provided by rational test procedures. For titanium alloys, the two rational fracture resistance test procedures that apply are Klc tests for brittle materials and Dynamic Tear (DT) tests for the entire range of strength and fracture resistance. The Ratio Analysis Diagram (RAD) is a framework for determining the significance of fracture resistance data in terms of stress level and crack size required for fracture. The RAD is derived from basic linear-elastic fracture concepts involving Klc and material yield strength however, either Klc or DT test data can be indexed to the RAD. Author (GRA)

N73-11534# Battelle Columbus Labs., Ohio.
ENGINEERING DATA ON NEW AEROSPACE STRUCTURAL MATERIALS Final Summary Report, Jan. 1970 - Jul. 1971
O. L. Deel and Harold Mindlin Wright-Patterson AFB, Ohio AFML Dec. 1971 195 p refs
(Contract F33615-70-C-1070; AF Proj. 7381)
(AD-746761; AFML-TR-71-249) Avail: NTIS CSCL 11/6

The major objectives of this research program were to evaluate newly developed structural materials of potential interest to the Air Force weapons system, and then to provide data sheet type presentations of engineering data for these materials. The effort covered in this report has concentrated on Udimet 700 sheet, X5090 sheet, AF2-1DA sheet, Inconel 625 sheet, HA-188 sheet, Custom 455 round bar, PH 14-8Mo sheet, and Ti-6Al-2Sn-4Zr-2Mo sheet. The properties investigated include tension, compression, shear, bend, impact, fracture toughness, fatigue, creep and stress-rupture, and stress corrosion at appropriate temperatures. Author (GRA)

N73-11535# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
MEASUREMENT OF INTERFACIAL ENERGIES IN SOLID STATE METALS AND ALLOYS Final Technical Report, 1 Mar. 1969 - 30 Jun. 1972
Lawrence E. Murr Jul. 1972 68 p refs
(Contract N00014-67-A-0269-0010; NR Proj. 031-735)
(AD-747267; USCEE-417) Avail: NTIS CSCL 11/6

The method of zero creep of small diameter 304 stainless steel wires coupled with scanning and transmission electron (shadowgraphic) microscopy of grain boundary-surface intersection grooves was used to measure average values for the surface free energy, F(S), and the grain boundary free energy, gamma (gb) at temperatures of 1060, 1160, 1260 and 1360C, from which the temperature coefficients of the specific interfacial free energies, were measured. Mean values of coherent twin boundary free energy/grain boundary free energy ratios were determined for low-torque twin-grain boundary intersections in thin foils of 304 stainless steel using techniques of transmission and diffraction electron microscopy. The techniques of transmission electron microscopy have been employed in a study of coherent annealing twins and their energetics in ultra-pure aluminum. The use of techniques developed for the measurement of interfacial free energies is expanded and discussed in connection with composite and dispersion-hardened systems. Particular emphasis on techniques of scanning electron microscopy are presented.
GRA

N73-11536# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CREEP IN BETA ALLOY OF TITANIUM IVT-1
N. V. Ageev, L. A. Petrova, L. P. Grankova, and T. M. Kozovskaya 9 Jun. 1972 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Metally (USSR), no. 2, 1971 p 163-167
(AD-747090; FTD-MT-24-1944-71) Avail: NTIS CSCL 11/6

In creep testing alloy IVT-1 it was discovered that if two specimens tested under identical conditions show different initial deformations, then, as a rule, the specimen with the greater initial deformation has lower creep than the specimen with the lower initial deformation. At test temperatures of 100-250C and loads of 120-75 kg/sq mm there was little increase in total deformation of the alloy specimens with an increase in time under the load. Thus, at the greatest applied stress of 120 kg/sq mm and a temperature of 100C there was a maximal increase in total deformation of 0.04%. The structure of the alloys was studied after creep testing at the test temperatures and stresses. Author (GRA)

N73-11537# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE METALLOGRAPHY OF ALUMINUM
Gunther Gonschior and Erna Weiland 25 Apr. 1972 14 p refs Transl. into ENGLISH from Neue Huette (East Germany), v. 15, no. 4, 1970 p 245-247
(AF Proj. 6010)

(AD-747086; FTD-HT-23-1579-71) Avail: NTIS CSCL 11/6
A metallographic method was described in which dislocation etchings are obtained in minimum time and microstructural details can be obtained from samples corresponding to purities of Al 99.99 and Al 99.7. The steps involved in the technique are grinding, electrolytic polishing, dislocation etching, and anodic oxidation. Some examples obtained with the aid of this method were described. The method provides data on the presence of two phases, their configurations, and distribution; the density and distribution of dislocations on the basis of etched figures; the orientation of the crystals; and recovery and recrystallization. Grain-size determination is also possible. The method is suitable for AlMg3 and AlMgSi also. Author (GRA)

N73-11538# Naval Research Lab., Washington, D.C.
THE ROLE OF FRACTURE TOUGHNESS IN LOW CYCLE FATIGUE CRACK PROPAGATION FOR HIGH STRENGTH ALLOYS Final Report
Thomas W. Crooker 20 Jun. 1972 16 p refs
(AD-747243; NRL-7422) Avail: NTIS CSCL 11/6
The trend toward broader application of high-strength structural alloys has increased the potential for failure by low-cycle fatigue crack propagation. There is a significant probability that complex structures will contain undetected cracks remaining from fabrication or that cracks will readily initiate from less severe fabrication defects. Under the repeated application of high stresses imposed on high-strength alloys, such cracks will rapidly grow in low-cycle fatigue. To guard against disastrous failures caused by cracks propagating to terminal fracture, high-strength structural alloys which also possess high levels of fracture resistance have been developed in recent years. The report describes the principal fatigue crack propagation characteristics derived from high fracture toughness and discusses the potential benefits available through the use of high-toughness alloys in cyclically loaded structures.
Author (GRA)

N73-11539# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE INFLUENCE OF CARBON CONTENT AND STRUCTURAL STATE ON THE ABRASIVE WEAR RESISTANCE OF IRON ALLOYS
A. Shcullepnikova and D. Zlatoustovskii 6 Jun. 1972 14 p refs Transl. into ENGLISH of Tr. Metalloved. Vopr. Metiznogo Proizv. Nauch. (USSR), no. 60, 1969 p 22-29
(AD-747078; FTD-HC-24-2067-71) Avail: NTIS CSCL 11/6
The study concerns U1, U3, U4, U7, U12, U20, U30 alloys heat treated and surfaced on ST.3 steel. The resistance of FE-C alloys to abrasive wear is determined by the initial value of ferrite blocks, the hardness and C content being equal. The lower the initial value of ferrite blocks, the higher the wear resistance. The surface friction of carbon alloys causes the size reduction of ferrite blocks which is particularly intensive in the initial period of the process over a friction path of 1-2 M.
Author (GRA)

N73-11540# Air Force Materials Lab., Wright-Patterson AFB, Ohio.
HEAT TREATMENT STUDY OF BETA EXTRUDED TITANIUM ALLOY Ti-6Al-6V-2 SN Technical Report, Apr. - Dec. 1971
R. J. Sajdak, R. F. Geisendorfer, J. A. Hall, and C. M. Pierce Jun. 1972 27 p refs
(AF Proj. 7351)
(AD-747207; AFML-TR-72-52) Avail: NTIS CSCL 11/6
A linear regression analysis was used to analyze mechanical property data from a statistically designed experiment which maximized the variability in heat treating parameters of a titanium alloy, Ti-6Al-6V-2Sn, beta extruded ribbed panel. Using the results of the linear regression analysis, a computer program was executed to predict mechanical properties. Nine heat treatment cycles were chosen to test the validity of the predicted mechanical properties. Generally, the yield strength and ultimate strength are slightly higher than predicted; reduction of area is about as predicted; elongation is slightly lower than predicted; and fracture toughness is lower than predicted. Two heat treatment cycles were singled out as yielding superior properties over the other heat treatment cycles investigated. Author (GRA)

N73-11541# Rensselaer Polytechnic Inst., Troy, N.Y. Materials Div.
THE EFFECTS OF GROWTH SPEED AND HEAT TREATMENT ON DEFORMATION OF ALIGNED Ag3Mg-AgMg AND Al-A-g2Al EUTECTICS
R. H. Bellows, Y. G. Kim, and N. S. Stoloff 31 Aug. 1972 28 p refs
(Contract N00014-67-A-0117-0010; NR Proj. 031-745)
(AD-747310; TR-2) Avail: NTIS CSCL 11/6
Tensile properties of aligned Ag3Mg-AgMg and Al-Ag2Al eutectics were determined as a function of growth speed at temperatures between -196C and 300C. Strength of Ag3Mg-AgMg increases with decreasing spacing, lambda at all test temperatures, but the strength of Al-Ag2Al is more dependent on eutectic grain size. Ordering of the Ag3Mg phase increases the effectiveness of interphase boundaries as barriers to slip and increases the strength of Ag3Mg-AgMg. Aging treatments to produce gamma in the Al-rich phase markedly increases strength of Al-Ag2Al. Fracture behavior of both alloys is discussed. Author (GRA)

N73-11542# Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics and Materials Science.
ON EXPERIMENTS REVEALING THE IMPORTANCE OF MATERIAL INSTABILITY FOR MODERN THEORIES OF PLASTICITY
James F. Bell May 1972 41 p refs
(Contract F44620-70-C-0082; AF Proj. 9782)
(AD-746689; AFOSR-72-1194TR) Avail: NTIS CSCL 11/6
Based upon the dictates of observed response functions for the loading of fully annealed crystalline solids, and upon the definitions and concepts which arise from these same observations, a description and theory of large plastic deformation of metals is developed. With particular reference to recent and continuing experiments involving consideration of more than one non-zero stress component, herein is delineated the importance of material instability phenomena in the form of the Savart-Masson effect when two or more uncoupled incremental stress components are present, and in the form of finite deformation modes arising in second order transitions which occur at fixed shear angles. The experimental results and the general theory derived from them are shown to present new and interesting fundamental problems both for science and for technology in this field.
Author (GRA)

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N73-11543 National Lending Library for Science and Technology, Boston Spa (England).
STUDY OF THE ADHESION OF POLYVINYL ACETATE TO STEEL
V. L. Vakula Oct. 1972 10 p refs Transl. into ENGLISH from Vysokomolekul. Soedin. (Moscow), v. 13, no. 10, 1971 p 776-771
(NLL-RTS-7520) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.00; 3 NLL photocopy coupons
It has been shown that as the time and temperature of contact increase, the strength of the polyvinyl acetate (PVA)-steel adhesive bond grows. The dependencies obtained are explained by the increase in effective contact area of the adhesive and substrate, as a result of rheological processes taking place. The strength of the polymer-metal bond depends on the chemical nature of the additives introduced and their concentration. During the breakdown of the PVA-steel composite, a fraction of the polymer, in practice, always remains on the surface of the substrate, while its quantity increases as the polymer-metal adhesive bond strength increases. Adhesive failure of the composites is the exception rather than the rule. Author

N73-11544 National Lending Library for Science and Technology, Boston Spa (England).

WETTING OF ALUMINA, MAGNESIA, ZIRCONIA, AND ALSO OF CARBIDES AND BORIDES OF VANADIUM, TITANIUM AND ZIRCONIUM BY PALLADIUM MELTS

N. A. Vatolin, V. F. Ukhov, O. A. Esin, and E. L. Dubininin Aug. 1972 17 p refs Transl. into ENGLISH from Tr. Inst. Met., Akad. Nauk SSR (Sverdlovsk), v. 20, no. 2, 1969 p 42-54 (NLL-RTS-7321) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.70; 6 NLL photocopy coupons

The wettability of aluminium oxide by pure metals and palladium-based alloys was investigated. It was shown that with an increase in the concentration of Fe, Co, Pb, Sb, and Cu the adhesion work is decreased, while with enrichment of the melt by Ni, W, Cr, Mn, Si and Al the adhesion work increases. The temperature dependence for the wetting of carbides and borides of titanium, vanadium and zirconium by silver was developed. It was found that with an increase in time, the wettability of TiB2, VB2, ZrB2, TiC, VC and ZrC by palladium and its alloys with silver increases significantly. A relationship exists between the wettability and the adhesion work of the Pd, Ag and Pd-Ag melts, and the type of backing and the electronic structure of melts. Author

N73-11545 National Lending Library for Science and Technology, Boston Spa (England).

PARTIAL DISCHARGES IN INSULATING MATERIALS: MEASUREMENT METHODS, APPLICATION

J. Wendling 19 Jun. 1972 30 p refs Transl. into ENGLISH from EDF Bull. de la Direction des Etudes et Rech., Ser. B, Reseaux Elec., Materiels Elec. (France), no. 1, 1971 p 43-70 (NLL-CE-Trans-5844-(9022.09)) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

Various methods of measuring partial discharges in insulating materials and the means of applying these methods to different types of equipment are discussed. The commercial use of these methods in locating heterogeneities in the insulation where the gradient is high is described. The procedure serves as a quality control measure during manufacturing of electric equipment. Author

N73-11546 National Lending Library for Science and Technology, Boston Spa (England).

REINFORCEMENT OF HEAT RESISTANT ALLOYS BY FIBRES

B. A. Klypin and A. M. Malov 18 Jul. 1972 13 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal (Moscow), no. 8, 1971 p 2-6 In ENGLISH and RUSSIAN (NLL-Trans-746-1193-(9022.401)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The effects of fiber stability, matrix composition, volume ratio of fibers, and physical-chemical interactions between fibers and matrices in heat resistant Ni-Cr-Al alloys reinforced with molybdenum and tungsten fibers are considered. It is observed that molybdenum alloy fiber reinforcement increases short-term stability, and tungsten fiber reinforcement permits higher stability at 1,100 to 1,200 C. Diffusion of small amounts of matrix elements into molybdenum alloy and tungsten fibers decreases recrystallization temperature of the fibers by about 200 C. Nickel alloys, reinforced with molybdenum alloy fibers, suffer changes in phase composition by intensive diffusion of molybdenum into the matrix. It is concluded that the investigated materials, reinforced with tungsten fibers, possess greater structural stability as long service materials. G.G.

N73-11547*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.

DEVELOPMENT OF ADVANCED MATERIALS COMPOSITES FOR USE AS INSULATIONS FOR LH2 TANKS Summary Report, 1 Jul. 1971 - 29 Apr. 1972

C. R. Lemons, C. R. Watts, and O. K. Salmassy Jun. 1972 176 p refs

(Contract NAS8-25973)

(NASA-CR-123928; MDC-G3677) Avail: NTIS HC$11.00 CSCL 11D

A study of internal insulation materials and fabrication processes for space shuttle LH2 tanks is reported. Emphasis was placed on an insulation system capable of reentry and multiple reuse in the Shuttle environment. Results are given on the optimization and manufacturing process scale-up of a 3D fiberreinforced foam insulation, BX-251-3D, derived from the Saturn S-4B internal insulation. It is shown that BX-251-3D can be satisfactorily installed in large-scale tanks under conditions that will permit a significant cost saving over the existing S-4B technology. Author

N73-11548*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

THERMAL PERFORMANCE OF 625-kg/cu m ELASTOMERIC ABLATIVE MATERIALS ON SPHERICALLY BLUNTED 0.44-RADIAN CONES

Andrew J. Champman Washington Nov. 1972 53 p refs (NASA-TM-X-2612; L-7974) Avail: NTIS HC $3.00 CSCL 11D

Spherically blunted 0.44-radian (25 deg) half-angle conical models coated with elastomeric ablative materials were tested in supersonic arc-heated wind tunnels to evaluate performance of the ablators over a range of conditions typical of lifting entry. Four test conditions were combinations of stagnation point-heat transfer rates of 2.3 and 4.5 MW/m2 and stagnation pressures of 20 and 2kN/m2. Afterbody values of heat transfer rate and pressure were 0.05 to 0.20 of stagnation point values. Stagnation enthalpy varied from 4.4 to 25 MJ/kg (1900 to 11000 Btu/lbm) and free-stream Mach number was in a range from 3.5 to 4. Ablative materials retained the spherical nose shape throughout tests at the lower heat transfer level, but receded, assuming a flattened nose shape, during tests at the high heat transfer level. The residue layer that formed on the conical after-body was weak, friable, and extensively cracked. The reference ablative material, which contained phenolic microspheres, generally retained the conical shape on the model afterbody. However, a modified ablator, in which phenolic microspheres were replaced with silica microspheres, deformed and separated from the undegraded material, and thereby produced a very uneven surface. Substrate temperatures and ablator recession were in good agreement with values computed by a numerical analysis. Author

N73-11549*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FORMULATION PROCEDURE AND SPECTRAL DATA FOR A COATINGS SYSTEM OPTIMALLY EMPLOYING THE HIGH INTRINSIC REFLECTANCE OF BARIUM SULPHATE

John B. Schutt, Earl Stromberg, Charles M. Shai, and John F. Arens Oct. 1972 16 p ref Submitted for publication (Proj. HEAO)

(NASA-TM-X-66082; X-765-72-400) Avail: NTIS HC $3.00 CSCL 11D

The use of polyvinyl alcohol as a binder for barium sulphate does not allow the intrinsically high reflectance of this material in the near vacuum ultraviolet to be optimally employed. In an effort to better utilize this property, completely inorganic coatings systems are described, where from the intrinsically high reflectance of barium sulphate in this spectral region can be gotten. Potassium sulphate turns out to be the preferred binder. Compositions, formulating procedures, and application techniques are included. For completeness, absolute and relative reflectance data are included for intra- and intersystem comparisons. Author

N73-11550*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

BASIC FAILURE MECHANISMS IN ADVANCED COMPOSITES

J. V. Mullin, V. F. Mazzio, and R. L. Mehan [1972] 114 p refs

(Contract NASw-2093)

(NASA-CR-121000; Rept-2420-N03) Avail: NTIS HC $7.75 CSCL 11D

Failure mechanisms in carbon-epoxy composites are identified as a basis for more reliable prediction of the performance of these materials. The approach involves both the study of local fracture events in model specimens containing small groups of filaments and fractographic examination of high fiber content engineering composites. Emphasis is placed on the correlation of model specimen observations with gross fracture modes. The effects of fiber surface treatment, resin modification and fiber

content are studied and acoustic emission methods are applied. Some effort is devoted to analysis of the failure process in composite/metal specimens. Author

N73-11551*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AN EVALUATION OF SOME UNBRAKED TIRE CORNERING FORCE CHARACTERISTICS
Tafford J. W. Leland Washington Nov. 1972 37 p refs
(NASA-TN-D-6964; L-8351) Avail: NTIS HC $3.00 CSCL 11D

An investigation to determine the effects of pavement surface condition on the cornering forces developed by a group of 6.50x13 automobile tires of different tread design was conducted at the Langley aircraft landing loads and traction facility. The tests were made at fixed yaw angles of 3,4,5, and 6 deg at forward speeds up to 80 knots on two concrete surfaces of different texture under dry, damp, and flooded conditions. The results showed that the cornering forces were extremely sensitive to tread pattern and runway surface texture under all conditions and that under flooded conditions tire hydroplaning and complete loss of cornering force occurred at a forward velocity predicted from an existing formula based on tire inflation pressure. Futher, tests on the damp concrete with a smooth tire and a four-groove tire showed higher cornering forces at a yaw angle of 3 deg than at 4.5 deg; this indicated that maximum cornering forces are developed at extremely small steering angles under these conditions. Author

N73-11552# National Bureau of Standards, Washington, D.C. Inst. for Materials Research
STANDARD REFERENCE MATERIALS: THE CHARACTERIZATION OF LINEAR POLYETHYLENE SRM 1475
Herman L. Wagner, ed. and Peter H. Verdier, ed. Sep. 1972 40 p refs Repr. from Natl. Bur. of Standards J. for Res., Sect. A. Phys. and Chem., v. 76A, no. 2, Mar.-Apr. 1972
(NBS-SP-260-42; LC-72-600250) Avail: SOD $0.45 as C13.10:260-42

A linear polyethylene standard reference material, SRM 1475 is described. This material is certified for weight average molecular weight, number average molecular weight, Z average molecular weight, molecular weight distribution, limiting viscosity number in several solvents, melt flow rate, and density. The experimental details of the determination and certification of these properties are given. Author

N73-11553*# Naval Ordnance Lab., White Oak, Md. Nonmetallic Materials Div.
CARBON FIBER COMPOSITES FOR CRYOGENIC FILAMENT-WOUND VESSELS
James V. Larsen and R. A. Simon 2 May 1972 28 p refs
(NASA Order C-10360-B)
(NASA-CR-120899; NOLTR-71-201) Avail: NTIS HC $3.50 CSCL 11D

Advanced unidirectional and bidirectional carbon fiber/epoxy resin composites were evaluated for physical and mechanical properties over a cryogenic to room temperature range for potential application to cryogenic vessels. The results showed that Courtaulds HTS carbon fiber was the superior fiber in terms of cryogenic strength properties in epoxy composites. Of the resin systems tested in ring composites, CTBN/ERLB 4617 exhibited the highest composite strengths at cryogenic temperatures, but very low interlaminar shear strengths at room temperature. Tests of unidirectional and bidirectional composite bars showed that the Epon 828/Empol 1040 resin was better at all test temperatures. Neither fatigue cycling nor thermal shock had a significant effect on composite strengths or moduli. Thermal expansion measurements gave negative values in the fiber direction and positive values in the transverse direction of the composites. Author

N73-11554# Explosives Research and Development Establishment, Waltham Abbey (England).
HIGH PERFORMANCE POLYURETHANE ELASTOMERS. PART 1: LABORATORY AGEING TRIALS
B. E. Brokenbrow, D. Sims, and J. Wright Jan. 1972 49 p refs
(ERDE-TR-77; BR-29466) Avail: NTIS HC $4.50

A range of polyurethane elastomers based on di-isocyanate prepolymers of polyether, hydroxyl-terminated polybutadiene, polyester adipate and caprolactone polyols have been prepared and their aging properties assessed under a wide variety of laboratory simulated environmental conditions, including exposure to dry air (80 to 100 C), ultraviolet radiation; immersion in oil at 100 C, STF (65 C) and water (50 to 100 C). Author (ESRO)

N73-11555# Explosives Research and Development Establishment, Waltham Abbey (England).
HIGH PERFORMANCE POLYURETHANE ELASTOMERS. PART 2: MILLABLE ELASTOMERS AND SYNTACTIC FOAMS
B. E. Brokenbrow, D. Sims, and J. Wright Jan. 1972 21 p refs
(ERDE-TR-83-Pt-2; BR-29104) Avail: NTIS HC$3.25

Polyurethane elastomers based on millable sulfur cured polycapro/lactone, polyoxy 1,4-butylene glycol and hydroxyl terminated polybutadiene/diisocyanate precursors, chain extended with unsaturated diols, together with liquid cast polyoxy 1,4-butylene glycol diisocyanate prepolymers filled with small hollow spheres (syntactic foams) were assessed to determine their resistance to water (80 C) and Standard Test Fluid (65 C). Two commercially supplied urethane elastomers, one based on a low molecular weight polyether/toluene diisocyanate prepolymer cured with methylene-bis-(2-chloroaniline), the other on a higher molecular weight polyether/4,4-methylene bis-cyclo-hexyl di-isocyanate prepolymer, cured with methylene bis-aniline were also assessed for comparison. A millable caprolactone urethane elastomer gave fair resistance to STF at 65 C coupled with a very low permeability to STF at 30 C, while a millable polyether urethane elastomer gave good resistance to water at 80 C. A low density buoyant polyether based syntactic foam, filled either with hollow glass or fly-ash sphere, gave good resistance to water at 80 C. Author (ESRO)

N73-11556# National Physical Lab., Teddington (England). Div. of Inorganic and Metallic Structure.
REFRACTORY GLASS CERAMICS
T. I. Barry, L. A. Lay, and R. Morrell Aug. 1972 17 p refs
(NPL-IMS-17) Avail: NTIS HC $3.00

A family of glass ceramics based on cordierite has been developed with usable strength up to 1150 C and a high degree of thermal shock resistance. These properties suggest the materials are suitable as cheap engineering ceramics for high temperature stressed applications, particularly gas turbines. The present state of development of these materials and their prospects in the future is outlined. The properties investigated so far of some members of the family are described, and the expected upper operating temperatures that the better grades of material can withstand on a long-term basis are given. Author (ESRO)

N73-11557# Defence Research Information Centre, Orpington (England).
THE EFFECT OF FLAWS ON THE PROPERTIES OF SILICON NITRIDE FILMS
V. F. Synorov et al Sep. 1972 6 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Neorgan. Materialy (Moscow), v. 6, no. 5, 1970 p 1002-1003
(DRIC-Trans-2902; BR-30276) Avail: NTIS HC $3.00

The most significant shortcoming in silicon nitride films is the charge instability, generally explained by the presence of electrically charged centers. Studies carried out on the structure of Al-Si3N4-Si showed the absence of drifting ions. Two types of trap were found to be responsible for charge instability with various activation energies. For an explanation of the causes of flaws in amorphic films of silicon nitride, a model of three-dimensional polymer SiN4 with flawed bonds (a flaw being defined as any disruption of an ideal ordered structure in a crystal body) is described. It has been shown that after prolonged annealing of the films examined in nitrogen and in vacuum, the concentration of traps was reduced. Author (ESRO)

N73-11558# National Swedish Inst. for Building Research, Stockholm.
HEAT TRANSFER IN FIBROUS MATERIALS
Claes G. Bankvall 1972 72 p refs

(PB-210117; D4-1972) Avail: NTIS HC $3.00; Svensk Byggtjanst, Box 1403 S-111 84 Stockholm, Sweden: HC SW.KR.18 CSCL 11E

Theories and measurements of the mechanisms of heat transfer in fibrous materials (e.g. insulation of mineral wool type), and measurements of these mechanisms are reported. The present work is part of a larger research program for investigating the behavior of fibrous material as thermal insulation.

Author (GRA)

N73-11559# Whittaker Corp., San Diego, Calif. Research and Development Div.

PPQ (POLYPHENYLQUINOXALINE) RESIN SYSTEMS FOR HIGH TEMPERATURE COMPOSITE MATERIALS Final Report, 12 Nov. 1971 - 12 Apr. 1972

Richard T. Rafter and Walter P. Fitzgerald, Jr. Jun. 1972 30 p refs

(Contract DAAG46-72-C-0048; DA Proj. 1B0-62113-A-661)

(AD-746273; AMMRC-CTR-72-10) Avail: NTIS CSCL 11/4

The subject program has been directed toward the development of the high-temperature resin system, poylphenylquinoxaline (PPQ), based on 3,3-diaminobenzidine (DAB) and 4,4-oxybisbenzil (OBB), through the use of a designed trifunctional crosslinking mechanism to provide a unified cured resin system with requisite thermomechanical capability as a laminating resin for end-use application in advanced weapons systems. Linear PPQ composites with Modmor-II carbon fiber reinforcement have displayed RT-flexural strengths as high as 301,300 psi, with residual thermoplasticity, however, at 700 F. On the other hand, trifunctionally cured WRD X-361 PPQ homopolymer has demonstrated complete retention of RT-flexural performance in Modmor-II flat laminates at 700 F. Each of these copolymer resin compositions could be readily fabricated into Modmor-II laminates exhibiting room temperature flexural strengths in excess of 200,000 psi. Author (GRA)

N73-11560# Hughes Aircraft Co., Culver City, Calif. Materials Technology Dept.

EXPLORATORY DEVELOPMENT OF PROTOTYPE MISSILE FUSELAGES Final Report, Jun. 1969 - 30 Sep. 1971

E. P. Lowe, L. B. Keller, and E. Orlowski Oct. 1971 154 p refs

(Contract F33615-69-C-1657; AF Proj. 7381)

(AD-746288; HAC-P-71-381; HAC-Ref-B6500; AFML-TR-72-4) Avail: NTIS CSCL 11/4

A practicable, molded-plastic, missile fuselage concept was successfully developed by the Hughes Aircraft Company utilizing a unique Quadrant Molding Process. The primary objective of the development was demonstration of the feasibility of producing such a missile fuselage with inexpensive, glass fiber-reinforced, composite materials with fabrication methods capable of high production at a low cost. A realistic structural comparison was made between the quadrant molded composite fuselage and a conventional metallic structure. Comparative manufacturing costs were also established and indicated that the composite fuselage is the more cost effective for all production quantities.

Author (GRA)

N73-11561# Lehigh Univ., Bethlehem, Pa. Physical Ceramics Lab.

KINETICS AND MECHANISMS OF SYNERGETIC PRESSURE SINTERING AND MECHANICAL BEHAVIOR OF HIGH STRENGTH CERAMICS Final Report, 1 Apr. 1969 - 30 Apr. 1972

R. M. Spriggs, D. P. H. Hasselman, M. R. Notis, R. B. Runk, and C. J. P. Steiner 30 May 1972 57 p refs

(Grant DA-ARO(D)-31-124-G1106; DA Proj. 200-61102-B-32-D)

(AD-745909; AROD-8045-10-MC) Avail: NTIS CSCL 11/2

The report presents a summary of the following research efforts: (1) a major effort was devoted to studying the synergetic effect of the gamma to alpha alumina phase transformation on pressure-sintering kinetics of high-density alumina ceramics. (2) An extensive program was also initiated with the purpose of relating diffusion coefficients observed for ceramics subjected to pressure-sintering or press-forging operations with interdiffusion coefficients observed in diffusion experiments. (3) In addition to the studies on basic mechanisms in the densification kinetics of ceramics, considerable attention was also devoted to studies of the mechanical behavior of ceramic materials. (4) Additional studies of the mechanical behavior of ceramic materials involved an analysis of fracture energies. Author (GRA)

N73-11562# McDonnell-Douglas Astronautics Co., Santa Monica, Calif.

DEVELOPMENT OF NONDESTRUCTIVE TEST TECHNIQUES FOR MULTIDIRECTIONAL FIBER-REINFORCED RESIN MATRIX COMPOSITES Final Report, Jun. 1969 - Jun. 1971

John L. Cook, Walter W. Reinhardt, and James E. Zimmer Wright-Patterson AFB, Ohio AFML Oct. 1971 213 p refs

(Contract F33615-69-C-1624; AF Proj. 7351; AF Proj. 7351)

(AD-746592; AFML-TR-71-187) Avail: NTIS CSCL 11/4

Described is research devoted to the study of the applicability of nondestructive analysis to the impregnated but uncured (B-stage) condition composite, evaluation of cured composite variability, relation of composite mechanical strength to location and severity of weave irregularities, and evaluation of the material elastic constants by means of ultrasonic velocity measurements verified through mechanical load versus strain data. The application of the ultrasonic attenuation C-scan mapping technique did not enable discrete areas of altered impregnation to be clearly detected. Both C-scan attenuation and ultrasonic velocity measurements were indicative of composite variability in the fully cured condition. Application of film radiography and ultrasonic attenuation measurements to an orthogonal construction frustum indicated that these techniques were feasible for inspection of such surfaces of revolution. Mechanical tests showed that tensile values were most seriously affected by weave defects or irregularities. Both ultrasonic C-scan attenuation and longitudinal and shear wave velocity measurements have been used to assess material variability and to predict elastic constants. Author (GRA)

N73-11563# Missouri Univ., Rolla. Dept. of Ceramic Engineering.

POLYNARY TELLURIDE GLASSES CONTAINING SILVER Technical Report, 1 Sep. 1971 - 31 Aug. 1972

H. E. Anthonis and Norbert J. Kreidl 31 Aug. 1972 7 p refs

(Contract N00014-69-A-0141-0003)

(AD-747333) Avail: NTIS CSCL 11/2

The addition of a monovalent element, for instance silver, made it possible to introduce substantial amounts of selenium in Si-As-Te glasses from which selenium normally volatilizes. The resulting homogeneous polyphase in transmitting glasses possess substantially higher softening ranges than any chalcogenide glasses studied to date. Author (GRA)

N73-11564# California Inst. of Tech., Pasadena. Dept. of Electrical Engineering.

ANALYSIS OF ALUMINUM OXIDE FILMS ON SILICON

Mototaka Kamoshida, James W. Mayer, and Ian V. Mitchell May 1972 59 p refs

(Contract F19628-71-C-0056; AF Proj. 5638)

(AD-747019; AFCRL-72-0319; SR-2) Avail: NTIS CSCL 11/3

Aluminum oxide exhibits novel and useful properties as a passivating layer on silicon surfaces. The study was concerned with the properties of hydrolytically grown aluminum oxide films on silicon. The study covered the influence of deposition temperature, of subsequent heat treatment and of anodization. The principal tool of measurement was 2 MeV He(+) ion backscattering technique; in addition etch rates were measured and electron diffraction patterns were taken. Aluminum oxide films deposited onto silicon substrates by hydrolysis of AlCl3 show marked differences in etch rates, electron diffraction patterns and chlorine content between films grown below 700C and above 800C. However, both film types are stoichiometric.

Author (GRA)

N73-11565# Aerospace Corp., El Segundo, Calif. Lab. Operations.

FORMATION OF NEW POLYMORPHS OF CARBON AND FLUID FLOW PATTERNS BY IRRADIATION OF SOLID CARBONS WITH A CO2 LASER

A. Greenville Whittaker, Lloyd S. Nelson, and Bernadine Tooper 31 Jul. 1972 43 p refs

(Contract F04701-72-C-0073)
(AD-747020; TR-0073(3250-40)-1; SAMSO-TR-72-114) Avail: NTIS CSCL 11/2

Several varieties of solid carbon under a blanket of rare gas near atmospheric pressure were irradiated at power densities up to about kw/sq cm with focused 10.6-micrometer-wavelength radiation from 0.25- to 30-kw continuous CO2-N2-He lasers. Craters or holes were formed that were lined and surrounded with light-reflecting white deposits. This material exhibited a high incidence of patterns of chaoite (white carbon) when examined by transmission and reflection electron diffraction. When both static and rapidly spinning samples of carbon were exposed to the laser radiation, deposits were formed with shapes that strongly suggested that the laser produced liquid carbon at pressures close to 1 atm. Finally, the production of crystal forms of carbon other than graphite or diamond at atmospheric pressure or below indicates that there are probably serious inconsistencies in the low-pressure region of the currently accepted phase diagram of carbon. Author (GRA)

N73-11566# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOME REGULARITIES IN THE PRECIPITATION OF MOLYBDENUM ORIENTED COATINGS FROM GASEOUS PHASE
A. I. Evstyukhin, D. D. Abanin, V. I. Melnikov, and Yu. A. Perlovich 9 Jun. 1972 18 p refs Transl. into ENGLISH from Met. i Metallovedenie Chistykh Metallov (USSR), no. 8, 1969 p 5-13
(AD-747082; FTD-MT-24-2010-71) Avail: NTIS CSCL 11/3

The paper describes an experiment in precipitation of molybdenum from gaseous phase in an attempt to determine the factors which affect the orientation of chemical vapor deposited coatings. In the experiment, high-temperature pyrolysis of molybdenum pentochloride was used. Application of the coating was accomplished at three fixed temperatures of the base: 1120, 1300, and 1430C. Two types of bases were used: rolled molybdenum, foil and tablets. X-ray analysis of the coatings was performed. Change in the temperature of the base and change in pressure of the gaseous phase were found to affect the coating process. Texture of the base was found not to have a dominant effect on texture of the coating. Author (GRA)

N73-11567# Naval Research Lab., Washington, D.C.
BEHAVIOR OF MATERIALS IN A SUBSURFACE OCEAN ENVIRONMENT Final Report
L. A. Beaubien, I. Wolock, C. L. Buchanan, and C. L. Whitman 14 Jul. 1972 111 p refs
(AD-747245; NRL-7447) Avail: NTIS CSCL 13/10

Information is presented on the deterioration in sea water of materials and undersea-system components, based on published and unpublished studies, and on authoritative opinions. The items chosen for evaluation are primarily those likely to be used in deep-ocean structure and systems. Materials included are metals, plastics and composites, ceramics, paper, natural fibers; components included are photographic materials, magnetic tape, electronic components, and propellants and explosives. Marine corrosion of metals is represented in the form of an annotated bibliography; the remaining entries consist of summaries of material and component behavior coupled with pertinent bibliographies. The form and scope of these summaries run from comprehensive evaluations in the areas of plastics and propellants to relatively brief opinions of authorities for items of lesser marine utility or occurrence. Author (GRA)

N73-11568# Naval Research Lab., Washington, D.C.
CHEMISTRY AND PHYSICS OF GLASS Semiannual Report, Period ending 30 Jun. 1972
C. C. Klick 30 Jun. 1972 7 p refs
(ARPA Order 2019)
(AD-747311; SAR-10) Avail: NTIS CSCL 11/2

The report briefly summarizes work on the structural characterization of a variety of glasses by advanced methods of X-ray and neutron diffraction, studies of the effects of high energy ion-implantation on the strength of silicate glasses, and an investigation of the properties of the luminescence observed during the fracture of glasses at very high stress levels. GRA

N73-11569# Horizons, Inc., Cleveland, Ohio.
SYNTHESIS OF NEW LOW TEMPERATURE PETROLEUM RESISTANT ELASTOMERS Annual Report, 4 Mar. 1971 - 3 Mar. 1972
Kennard A. Reynard, Richard W. Sicka, and Selwyn H. Rose Jun. 1972 31 p refs
(Contract DAAG46-71-C-0103; DA Proj. 1T0-62105-A-329)
(AD-745900; AMMRC-CTR-72-8) Avail: NTIS CSCL 11/10

The chemical and physical properties of three petroleum resistant elastomers suitable for low temperature conditions are presented. Several process studies are described. The effect of cyclics on the course of derivatization was studied, but the results are inconclusive. The pH during hydrolysis appears to affect the molecular weight of the product. The removal of salts from the derivatized copolymer by several different methods was investigated. Author

N73-11570# Pennsylvania State Univ., University Park. Materials Science Lab.
GLASSY CARBON, ALLOYS Semiannual Technical Report, 1 Jan. - 30 Jun. 1972
P. L. Walker, Jr. 27 Jul. 1972 66 p
(Contract DAHC15-71-C-0290)
(AD-746883) Avail: NTIS CSCL 11/2

Glassy carbons containing the element iron were prepared by pyrolysis in an inert atmosphere from copolymers of furfuryl alcohol (PFA) and organometallics such as ferrocene dicarboxylic acid (FDA) and vinyl ferrocene (VF) at temperatures from 500C to 970C. The purpose of this study was to determine the possibilities of ultimately modifying the structure and properties of glassy carbon by the addition of organometallic derivatives of the element iron to organic precursors of glassy carbon. In this report, attention will be directed toward the study of the distribution of iron and its effects on the morphology and mechanical properties of the glassy carbon matrix as a function of pyrolysis temperature and iron content. Author (GRA)

N73-11571# General Electric Co., Philadelphia, Pa. Missile and Space Div.
METAL OXIDE STUDIES Final Report
Milton J. Linevsky May 1972 30 p refs
(Contract F30602-69-C-0380; ARPA Order 1649; AF Proj. 1649)
(AD-746687; RADC-TR-72-161) Avail: NTIS CSCL 07/4

Emission and absorption spectra over mixtures of liquid uranium-urania have been obtained using the carbon-tube furnace facility. In the temperature range of approximately 2100C to 2400C a complex system of bands has been observed in the region of 4800 A to 7000A. The wavelength region from 5900 A to 6000 A is especially noteworthy since it contains a very intense highly dense band system. By comparison with the temperature coefficient of a known uranium line it was shown that the most intense feature in this region was due to either UO or UO2. Flame studies have been initiated using UF6 seeded into cyanogen/oxygen and hydrogen/nitrous oxide flames. Spectra of these flames have been observed and are completely different in nature from the furnace results. The oscillator strength of the (0,0) and the (1,1) band of the E singlet Sigma - X singlet Sigma transition in ThO has been obtained. GRA

N73-11572# Stevens Inst. of Tech., Hoboken, N.J. Lab. for Balloon Technology.
A COMPENDIUM OF THE MECHANICAL PROPERTIES OF POLYETHYLENE BALLOON FILMS Interim Report
Harold Alexander and Dan Weissman Jan. 1972 151 p refs
(Contract F19628-69-C-0069; AF Proj. 5710)
(AD-746678; ME-RT-72001; AFCRL-72-0068; SR-2) Avail: NTIS CSCL 11/9

During the process of establishing test procedures that can be used in determining the suitability of various polyethylene films for balloon use and in subsequent testing of various balloon and balloon candidate materials much information has been collected on the mechanical properties of these films and the structural factors affecting them. This information includes the results of an extensive low temperature biaxial failure test sequence, a detailed discussion of the relationship of structure to mechanical properties and mechanical behavior, experimentation for the establishment of a failure criterion for balloon films,

the development of an approximate constitutive theory for polyethylene balloon films, and a discussion of the effect of orientation balance on mechanical properties. It is the purpose of the report to place this information at the disposal of the ballooning community. Author (GRA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

N73-11573*# Mississippi State Univ., State College.
MAGNITUDE ERROR BOUNDS FOR SAMPLED-DATA FREQUENCY RESPONSE OBTAINED FROM THE TRUNCATION OF AN INFINITE SERIES, AND COMPENSATOR IMPROVEMENT PROGRAM Final Report, 1 Sep. 1971 - 31 Aug. 1972
Jerrel R. Mitchell 31 Aug. 1972 14 p refs
(Contract NAS8-21377)
(NASA-CR-123917) Avail: NTIS HC $3.00 CSCL 12A

The frequency response method of analyzing control system performance is discussed, and the difficulty of obtaining the sampled frequency response of the continuous system is considered. An upper bound magnitude error equation is obtained which yields reasonable estimates of the actual error. Finalization of the compensator improvement program is also reported, and the program was used to design compensators for Saturn 5/S1-C dry workshop and Saturn 5/S1-C Skylab. N.E.N.

N73-11574*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
AN ADAPTIVE SCHEME FOR OBSERVING THE STATE OF AN UNKNOWN LINEAR SYSTEM
Robert L. Carroll and D. P. Lindorff Sep. 1972 6 p refs
(Grant NGL-07-002-002)
(NASA-CR-129172; TR-72-8) Avail: NTIS HC $3.00 CSCL 12A

A full order adaptive observer is described for observing the states of a single-input single-output observable continuous differential system with unknown parameters. Convergence of the observer states to those of the system is accomplished by directly changing the parameters of the observer using an adaptive law based upon Liapunov stability theory. Observer eigenvalues may be freely chosen. Some restriction is placed upon the system input in that it must be sufficiently rich in frequencies in order to insure convergence. Author

N73-11575*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
AN ADAPTIVE OBSERVER FOR SINGLE-INPUT SINGLE-OUTPUT LINEAR SYSTEMS
Robert L. Carroll and D. P. Lindorff Oct. 1972 27 p refs
(Grant NGL-07-002-002)
(NASA-CR-129193; TR-72-10) Avail: NTIS HC $3.50 CSCL 12A

It is shown that the full order adaptive observer for single input, single output, observable, continuous, stable, linear differential systems in the absence of a deterministic or random disturbance vector guarantees the vanishing of observation error, regardless of the size of the constant or slowly varying parameter ignorance. The observer parameters are directly changed in a Liapunov adaptive way so as to eventually yield the unknown full order Luenberger observer. The observer poles throughout may be placed freely in the stable region and no derivatives are required in the adaptive law. Author

N73-11576*# Connecticut Univ., Storrs. Dept. of Electrical Engineering.
AN EFFICIENT ALGORITHM FOR CALCULATION OF THE LUENBERGER CANONICAL FORM
D. Jordan and B. Sridhar Oct. 1972 10 p refs
(Contract NGL-07-002-002)
(NASA-CR-129174; TR-72-9) Avail: NTIS HC $3.00 CSCL 12A

An algorithm is suggested to obtain the Luenberger canonical form for multivariable systems. The method computes the canonical form directly without having to compute the transformation matrix. In addition, there is a large reduction in the number of calculations. The reduced computations along with Gaussian techniques lend to greater inherent accuracy and the ability to refine the solution with additional computations. Author

N73-11577# Weapons Research Establishment, Salisbury (Australia).
A LEAST SQUARES, CURVE FITTING METHOD SUITABLE FOR BOTH PERIODIC AND APERIODIC DATA
C. A. J. Fletcher Jun. 1972 42 p refs
(WRE-TN-688(WR/D)) Avail: NTIS HC $4.25

A least squares, curve fitting method is developed which uses an ascending series of cosine and sine terms or a series of Chebyshev polynomials in the approximating function for fitting periodic or aperiodic data and data that are not measured at equal intervals. A moving average is first applied to the data and up to 50 semi-smoothed points are selected. Then this set of data is smoothed in the normal manner. A goodness of fit parameter called the coefficient of determination is described, and a method is given whereby the coefficient of determination is utilized to find the optimum number of terms in the approximating function. The curve-fitting method has been incorporated into a computer program, subroutine CURVE, written in Fortran 2 to suit an IBM 7090. A listing of CURVE is given. Author

N73-11578# Kyoto Univ. (Japan). Research Inst. for Fundamental Physics.
WEYL TRANSFORMATIONS AND POINCARE GAUGE INVARIANCE
Alexander Bregman Aug. 1972 49 p refs
(RIFP-160) Avail: NTIS HC $4.50

Invariance under Weyl scale transformations and Poincare gauge invariant matter Lagrangian is established by introducing a minimally coupled vector gauge field and a Weyl invariant modified spin gauge field. The identities governing the corresponding modified matter Lagrangian are derived in a form that is manifestly covariant under both Weyl and Poincare gauge transformations. In particular it is shown that the covariant divergence of the energy-momentum tensor is proportional to a set of Lorentz force type terms. The case that the vector gauge field is related to the derivative of a scalar field is examined; it is found that use of the simplest possible free Lagrangians for the various fields leads to a modification of the Brans-Dicke theory corresponding to the presence of torsion and an asymmetric energy-momentum tensor. Author

N73-11579# Technische Universitaet, Brunswick (West Germany).
ON THE CLASSIFICATION OF THE CONDITIONS OF A STOCHASTIC STARKE-AUTOMATION Ph.D. Thesis [ZUR KLASSIFIKATION DER ZUSTAENDE EINES STOCHASTISCHEN STARKE-AUTOMATEN]
Hans-Georg Harnisch 25 Feb. 1972 72 p refs In GERMAN
Avail: NTIS HC $5.75

Definitions and properties of Markov chains are used to define transient and recurring properties of a stochastic Starke automation. Conditions for the transfer of special properties in the basic model to the actual prototype are reported.
Transl. by G.G.

N73-11580# Helsinki Univ. of Technology, Otaniemi (Finland).
EIGENFUNCTIONALS OF THE ONE DIMENSIONAL TRANSPORT OPERATOR IN MODAL APPROXIMATIONS
Pekka Silvennoinen 1972 19 p refs Sponsored by Finnish Atomic Energy Comm.
(APS-Ph-87; ISBN-951-666-005-3) Avail: NTIS HC $3.00

Eigendistributions of the linear Boltzmann operator are constructed in modal approximations. The formalism is a generalization of the conventional multigroup theory. Eigendistributions consist of the principal value functionals and the derivatives of the delta-distribution. The customary proof of completeness of the normal models is not applicable here. In a simple case of symmetric scattering an auxiliary set of functionals is shown to be complete when augmented with the ordinary discrete eigenfunctions. Author

N73-11581# Technische Universitaet, Brunswick (West Germany). Naturwissenschaftlichen Fakultaet.
INVESTIGATION OF THE EIGENVALUES AND EIGENFUNCTIONS OF HILL DIFFERENTIAL EQUATIONS IN DEPENDENCE ON A DISTURBING PARAMETER Ph.D. Thesis [UNDERSUCHUNGEN DER EIGENWERTE UND EIGENFUNKTIONEN DER HILLSCHEN DIFFERENTIALGLEICHUNG IN ABHAENGIGKEIT VON EINEM STOERPARAMETER]
Joern Schmalmack 5 Nov. 1971 62 p refs In GERMAN
Avail: NTIS HC $5.25

The application of perturbation methods to solve linear eigenvalue problems is reported. Considered is a Hill differential equation y'' + (lambda + p(t))y = 0 where the function p is substituted by mu p so that the boundary value problem constitutes a perturbation problem of the undisturbed problem at mu = 0. It is assumed that p is a steady, real value pi-periodic function of the real variable t, and that lambda and mu are two complex parameters. It is shown that eigenvalues and eigenfunctions in power series expansions can be used to investigate changes in eigenvalue lambda and eigenfunction y with the perturbation parameter mu. Transl. by G.G.

N73-11582# Ruhr Univ., Bochum (West Germany). Abteilung fuer Mathematik.
GROUP THEORY RESEARCH ON EQUAL AFFINITY GEOMETRIES Ph.D. Thesis [GRUPPENTHEORETISCHE UNTERSUCHUNG AEQUIAFFINER GEOMETRIEN]
Heinz-Reiner Friedlein 1971 75 p refs In GERMAN
Avail: NTIS HC $5.75

Group theoretical studies on equally projective geometric spaces that possess in every direction nonidentical translational planes (s'-structure) are reported. An algebraic description of s'-spaces is given by allotting to the geometric points classes of suitable products from n-translational planes. The connections between s'-planes and Moufang planes are determined and it is concluded that an s'-plane is not a Moufang plane if quasi-bodies with distributors exist. Transl. by G.G.

N73-11583# Hamburg Univ. (West Germany).
AN ALGEBRAIC ANALYSIS OF THE AFFINITY OF PLANE SURFACES THROUGH VECTOR SPACES Ph.D. Thesis [EINE ALGEBRAUSUERUNG DER AFFINEN EBENEN DURCH VERALLGEMEINERTE VEKTORRAEUME]
Gerd Duehl 16 Feb. 1972 90 p refs In GERMAN
Avail: NTIS HC $6.50

An algebraic analysis of affine plane surfaces through vector spaces is developed. Comparison of this method is made with the numerical procedures for solving Hilbert spaces and projective planes. Mathematical models are presented to describe general vector space theories, the association of affine planes, and the process for solving specific vector space problems. Transl. by P.N.F.

N73-11584# RAND Corp., Santa Monica, Calif.
ON A BRACHISTOCHRONE PROBLEM OF VICTORR ERMA
Kenneth V. Saunders Jul. 1972 19 p refs
(P-4749) Avail: NTIS HC $3.00

The following variation of a classical brachistochrone is considered: the particle must start and end at the same elevation with horizontal velocities, and must never fly-off the curve of its own inertia. First, it is shown that the problem can be reduced to that of finding brachistochrones that start horizontally and go to a specified vertical line, the corresponding particles constrained to never fly-off of their own inertia. This problem is then formulated as an optimal control problem with a state-dependent inequality constraint on the control. It is then shown that, strictly speaking, the problem has no solution but that interesting local extrema can be found. Graphs of these extrema are given and resulting times are compared with those for the corresponding classical brachistochrone. Author

N73-11585*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MATHEMATICS OF PROFILE INVERSION
Lawrence Colin, ed. Aug. 1972 630 p refs Workshop held at Moffett Field, Calif., 12-16 Jul. 1971
(NASA-TM-X-62150) Avail: NTIS HC $33.50 CSCL 12A

One-dimensional and multi-dimensional inversion techniques are used to obtain physical data from remote atmospheric and ionospheric soundings. For individual titles, see N73-11586 through N73-11630.

N73-11586* Atmospheric Environment Service, Toronto (Ontario).
A REVIEW OF SOME ASPECTS OF INFERRING THE OZONE PROFILE BY INVERSION OF ULTRAVIOLET RADIANCE MEASUREMENTS c13
Carlton L. Mateer *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 24 p (For availability see N73-11585 02-19)
CSCL 03B

The mathematical inversion of light-scattering observations to obtain the atmospheric ozone profile is discussed in terms of the filtering properties of the physical and mathematical processes for different spatial scales. Within this context, it is shown that the physical process of scattering acts as a low pass filter; which transfers large-scale profile information efficiently to radiance observations but very strongly attenuates small- or fine-scale profile information. To avoid domination of the mathematical inversion by the random error of radiance measurements, an equivalent spatial-scale filtering in the inversion procedure is essential. The available evidence suggests that mathematical inversion to obtain the low level ozone profile below 25 to 30 km is either inferior to or no better than the statistical estimation of the profile using total ozone as predictor. However, inversion profiles for high level ozone above 25 to 30 km appear to have moderately good accuracy. Author

N73-11587* Oxford Univ. (England). Clarendon Lab.
STATISTICAL RETRIEVAL TECHNIQUES FOR SOUNDING THE METEOROLOGICAL STRUCTURE OF THE ATMOSPHERE c13
C. D. Rodgers *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
CSCL 04A

Statistical retrieval methods for remote sounding are reviewed. Methods are given for constraining an essentially incomplete problem by means of the known statistical behavior of the solution. Information content of the observations and the meteorological structure are discussed. Linear versions of maximum probability and minimum variance methods are given in some detail, and extensions to the nonlinear case are described. Author

N73-11588* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A REVIEW OF NONSTATISTICAL TECHNIQUES FOR THE ESTIMATION OF VERTICAL ATMOSPHERIC STRUCTURE FROM REMOTE INFRARED MEASUREMENTS c13
B. J. Conrath and I. Revah *In its* Math. of Profile Inversion Aug. 1972 14 p (For availability see N73-11585 02-19)
CSCL 04A

Mathematical techniques used in atmospheric profile inversion are reviewed, with the discussion limited to methods that do not require extensive information on the statistical properties of the profiles. The basic problem of the calculation of vertical profiles from noise contaminated infrared spectral measurements is examined. Three specific examples of methods of solution are given: the iterative minimum estimation method, a second linear iterative method, and the algorithm of Chahine. Satellite data are used in an empirical comparison of the methods. Several factors are considered, including the stability of solutions, convergence behavior of the iterative methods, and dependence of the solutions on the first guess, a factor that is particularly important in the treatment of data from other planets. Author

N73-11589* National Environmental Satellite Service, Suitland, Md.
STATISTICAL VERSUS NONSTATISTICAL TEMPERATURE INVERSION METHODS c13
W. L. Smith and H. E. Fleming *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 7 p (For availability see N73-11585 02-19)
CSCL 04A

Vertical temperature profiles are derived from radiation

measurements by inverting the integral equation of radiative transfer. Because of the nonuniqueness of the solution, the particular temperature profile obtained depends on the numerical inversion technique used and the type of auxiliary information incorporated in the solution. The choice of an inversion algorithm depends on many factors; including the speed and size of computer, the availability of representative statistics, and the accuracy of initial data. Results are presented for a numerical study comparing two contrasting inversion methods: the statistical-matrix inversion method and the nonstatistical-iterative method. These were found to be the most applicable to the problem of determining atmospheric temperature profiles. Tradeoffs between the two methods are discussed. Author

N73-11590* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RECENT DEVELOPMENTS IN THE INVERSION BY THE METHOD OF RELAXATION c13
Moustafa T. Chahine *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
(Contract NAS7-100)
CSCL 04A

The relaxation method for inverse solution of the full radiative transfer equation is generalized to solve for all the atmospheric parameters that appear in the integrand as functions or functionals, without any a priori information about the expected solution. Illustrations are presented using the 7.5 micron CH4 band for determining temperature profiles in the Jovian atmosphere, and the 6.3 micron band for determining the water vapor mixing ratio in the earth's atmosphere. Author

N73-11591* Florida State Univ., Tallahassee.
LIMB RADIANCE INVERSION: ITERATIVE CONVERGENCE FOR A NONLINEAR KERNAL c30
John C. Gille *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
CSCL 03A

The features of the limb inversion problem that differentiate it from the nadir problem are described; the most important of these are the sharply peaked weighting functions and the nonlinear kernel that arises because the atmosphere is required to be in hydrostatic balance. The problem may be split into two parts: given the pressure at one level and the measured radiances, can the temperatures be retrieved? And how can the pressure be obtained at one level? The second problem is shown to depend on the first, which is solved iteratively. The convergence properties and final accuracies are presented. Inversion to obtain trace constituents is briefly discussed. Author

N73-11592* Weapons Research Establishment, Salisbury (Australia).
ACOUSTIC RADAR SOUNDING OF THE LOWER ATMOSPHERE c13
L. G. McAllister *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p (For availability see N73-11585 02-19)
CSCL 04A

Acoustic radar sounding techniques were used to measure the wind velocity and direction in the first 300 m of the atmosphere. Angle-of-arrival and Doppler techniques were developed to obtain two independent measurements of the wind field. These techniques and preliminary experimental results are described briefly. Author

N73-11593* Lincoln Lab., Mass. Inst. of Tech., Lexington.
ATMOSPHERIC RADAR SOUNDING c13
R. K. Crane *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
(Contract NAS5-21544)
CSCL 04A

Monostatic and bistatic radar techniques for the measurement of the structure of volume targets in the troposphere and lower stratosphere are reviewed. The targets considered are thin turbulent layers in the lower stratosphere and rain in the troposphere. The measurements of scattering from thin turbulent layers show that layers are generally detected at or near the tropopause, and in 31 out of 34 sets of measurements, layers were detected above the tropopause in the lower 10 km of the stratosphere. The threshold for turbulent layer detection corresponds to an equivalent thickness product of ten to the minus 13th power times the cube root of m at a range of 100 km and for layers with less than 1000 m thickness. The measurement of scattering by rain shows that in the New England area both convective and widespread rain consists of a number of small cells. On average, the cells appear to have a half-intensity width of 3 to 4 km as measured with a radar system with a 1.8 km resolution cell size for cells at 100 km range. Author

N73-11594* Naval Electronics Lab. Center, San Diego, Calif. Propagation Technology Div.
FINE STRUCTURE OF THE LOWER ATMOSPHERE AS SEEN BY HIGH RESOLUTION RADAR c13
J. H. Richter, E. E. Gossard, and D. R. Jensen *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 8 p (For availability see N73-11585 02-19)
CSCL 04A

A ground-based vertically pointing FM-CW radar is described that permits remote probing of the refractive index structure in the troposphere. The radar has the characteristics of extremely high sensitivity, ultrahigh range resolution, and close minimum detection range without clutter. The sounder routinely detects layer structures in the lower troposphere. These layers are always associated with gradients in the vertical refractive index profile, and are frequently very thin, approaching the resolution of the radar (1 m). Very often they are perturbed by wave motions. Examples of various wave patterns are presented, and an explanation is given for organized substructures frequently superimposed on larger scale wave motions. Author

N73-11595* Stanford Research Inst., Calif. Atmospheric Sciences Lab.
LIDAR PROBING OF THE ATMOSPHERE: SOME QUANTITATIVE ASPECTS c16
R. T. H. Collis and E. E. Uthe *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 9 p (For availability see N73-11585 02-19)
CSCL 20E

Lidar uses laser energy in radar fashion to observe atmospheric backscattering as a function of range. Because of the short optical and near-optical wavelengths used, very small particles and even the gaseous molecules cause significant scattering. This can complicate the evaluation of the observations by introducing attenuation along the path as a second unknown into the lidar equation. In many cases, however, the observations may be interpreted directly on a qualitative basis and show the distribution of particulate matter in clear air or enable the dimensions of visible cloud to be measured accurately. In other cases, particularly where additional data are available, quantitative solutions can provide useful information on remote targets such as tenuous smoke clouds or haze layers. Examples of such observations are given, illustrating the computational approach to the evaluation of the volume concentration of natural dust and haze layers in the lower atmosphere and the mass concentration of a smoke plume. In both cases lidar data are related to independently obtained data on the particulate concentrations involved.
Author

N73-11596* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
CURRENT METHODS OF RADIO OCCULTATION DATA INVERSION c07
Arvydas J. Kliore *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 16 p (For availability see N73-11585 02-19)
(Contract NAS7-100)
CSCL 20N

The methods of Abel integral transform and ray-tracing inversion have been applied to data received from radio occultation experiments as a means of obtaining refractive index profiles of the ionospheres and atmospheres of Mars and Venus. In the case of Mars, certain simplifications are introduced by the assumption of small refractive bending in the atmosphere. General inversion methods, independent of the thin atmosphere approximation, have been used to invert the data obtained from the radio occultation of Mariner 5 by Venus; similar methods will be used

to analyze data obtained from Jupiter with Pioneers F and G, as well as from the other outer planets in the Outer Planet Grand Tour Missions. Author

N73-11597* Polytechnic Inst. of Brooklyn, N.Y.
ERRORS INCURRED IN PROFILE RECONSTRUCTION AND METHODS FOR INCREASING INVERSION ACCURACIES FOR OCCULTATION TYPE MEASUREMENTS c13
S. H. Gross and J. A. Pirraglia *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 15 p (For availability see N73-11585 02-19)
(Grant NGR-33-006-047)
CSCL 03B

A method for augmenting the occultation experiment is described for slightly refractive media. This method which permits separation of the components of the gradient of refractivity, appears applicable to most of the planets for a major portion of their atmospheres and ionospheres. The analytic theory is given, and the results of numerical tests with a radially and angularly varying model of an ionosphere are discussed. Author

N73-11598* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PROFILE INVERSION IN PRESENCE OF RAY BENDING c30
H. Andrew Wallio and Mario D. Grossi (Raytheon Co., Sudbury, Mass.) *In its* Math. of Profile Inversion Aug. 1972 17 p (For availability see N73-11585 02-19)
(Contracts NAS1-9700; NASw-1772)
CSCL 03B

Inversion of radio occultation data for planetary atmospheres and ionospheres has been performed using the seismological Herglotz-Wiechert method, as adapted by Phinney and Anderson to the radio-occultation case. Profile reconstruction performed in computer simulated experiments with this approach has been compared with the ones obtained with the straight-ray Abel transform. For a thin atmosphere and ionosphere, like the ones encountered on Mars, microwave occultation data can be inverted accurately with both methods. For a dense ionosphere like the sun's corona, ray bending of microwaves is severe, and recovered refractivity by the Herglotz-Wiechert method provides significant improvement over the straight-ray Abel transform: the error reduces from more than 60% to less than 20% at a height of 60,000 km above the base of the corona. Author

N73-11599* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
ERROR ANALYSIS IN THE MARINER 6 AND 7 OCCULTATION EXPERIMENTS c30
Richard W. Stewart and Joseph S. Hogan *In its* Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
CSCL 03B

The Mariner 6 and 7 occultation experiments provide sets of Doppler residuals from which physical properties of the Martian atmosphere may be derived, such as the ionospheric electron density distribution and the lower atmosphere temperature profile. The Doppler residuals contain both systematic and random errors. The former are removed during the data reduction, and the latter are analyzed to yield error limits on the derived physical properties of the atmosphere. Author

N73-11600* Raytheon Co., Sudbury, Mass.
ERROR ANALYSIS OF BENT RAY RADIO OCCULTATION MEASURMENTS c07
R. L. SaintGermain *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 5 p (For availability see N73-11585 02-19)
CSCL 20N

There are two types of experimental measurement errors of the Doppler data associated with the radio occultation, random and systematic. Random errors are due to thermal noise in the transmission channel, and the phase lock loop, and quantization error in the digital circuitry. These are called noise type errors. The systematic errors are due to geometric uncertainty and equipment phase instability. Considered is the amount of uncertainty, due to random measurement errors, in the refractivity profiles reconstructed by this type of indirect sensing experiment. A class of refractivity profiles is defined which approximately fit the set of measured data. Bounds are placed on the extent of this class of solution profiles. To accomplish this, the sensivity of the reconstructed refractivity profiles to errors in the measured quantity and the statistics of the errors in the measurement are examined. Author

N73-11601* Stanford Univ., Calif.
AN OCCULTATION SATELLITE SYSTEM FOR DETERMINING PRESSURE LEVELS IN THE ATMOSPHERE c13
Steven G. Ungar and Bruce B. Lusignan *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 13 p (For availability see N73-11585 02-19)
CSCL 04A

An operational two-satellite microwave occultation system will establish a pressure reference level to be used in fixing the temperature-pressure profile generated by the SIRS infrared sensor as a function of altitude. In the final error analysis, simulated data for the SIRS sensor were used to test the performance of the occultation system. The results of this analysis indicate that the occultation system is capable of measuring the altitude of the 300-mb level to within 24 mrms, given a maximum error of 2 K in the input temperature profile. The effects of water vapor can be corrected by suitable climatological profiles, and improvements in the accuracy of the SIRS instrument should yield additional improvements in the performance of the occultation system. Author

N73-11602* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE P PRIME(f) TO N(h) INVERSION PROBLEM IN IONOSPHERIC SOUNDINGS c13
John E. Jackson *In its* Math. of Profile Inversion Aug. 1972 13 p (For availability see N73-11585 02-19)
CSCL 04A

A general review is given of the inversion techniques used to derive the ionospheric electron density N as a function of altitude h from group path P versus frequency f measurements obtained by vertical incidence ionospheric sounders. The paper discusses the medium under investigation, the experimental techniques used to obtain the P(f) data, the theoretical considerations leading to the integral equation relating P(f) to N(h), and the assumptions made in the inversion process. The lamination inversion technique is then presented, with special attention given to mathematical difficulties arising from discontinuities in the P(f) function, infinities in the integrand, and in some cases unknown integration limits. Methods outlined for minimizing the uncertainties due to discontinuities include the use of redundant information - that is the two distinct P(f) functions available for a given N(h) profile - and the use of models based on statistical data. Mathematical procedures are discussed that increase significantly the efficiency and accuracy of the required numerical integrations. The accuracy of the inversion technique is deduced by comparing the resulting N(h) profile with N(h) data obtained by simultaneous but independent observations. Author

N73-11603* Communications Research Centre, Ottawa (Ontario).
THE CALCULATION OF ELECTRON DENSITY PROFILES FROM TOPSIDE IONOGRAMS: METHOD AND APPLICATIONS c13
G. E. K. Lockwood *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p (For availability see N73-11585 02-19)
CSCL 04A

A method for converting topside sounder ionograms into topside electron density profiles is discussed. The lamination method used is modified to take into account the variation of electron density and magnetic field within each lamination. Also included is a change of variable to produce a finite integrand of the integral involved, an iteration scheme that permits convergence on an initially unknown density, a second iteration scheme to overcome the problem of an uncertainty in the electron density at the satellite, and a modification to compensate for the changing satellite altitude over the duration of the sounding. Two applications of the technique are discussed: field-aligned traces for computing field-aligned profiles and computer-aided systems for scaling ionograms. Author

N73-11604* Informatics, Inc., Palo Alto, Calif.
NUMERICAL METHODS FOR REDUCTION OF TOPSIDE IONOGRAMS c13
L. McCulley *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
CSCL 04A

Several alternative methods for solving the group height equation are presented. Three of these are now in operation at Ames Research Center and use data contained in a single ionogram trace. From the data an electron density profile N(h) is computed. If the ionogram also exhibits other traces, reverse ionogram traces are computed, using the N(h) profile, for comparison with the redundant data. When agreement is poor, the initial data trace is reinterpreted, another N(h) profile computed, and the reverse traces generated once again. This process is repeated until a desired degree of consistency is achieved. To reduce the necessity for human intervention and eliminate decision making required in conjunction with the preceding methods, a method is proposed that accepts as input, all data from a single ionogram. In general, no electron density function will satisfy these data exactly, but a best N(h) profile can be computed. Finally, a method is described that eliminates the need to assume that the ionosphere is spherically stratified. Horizontal gradients in electron density are detected and accounted for by processing several ionograms from the same satellite pass simultaneously. This idea is derived as an extension of one of the basic methods. Author

N73-11605* National Oceanic and Atmospheric Administration, Boulder, Colo.
THE MATHEMATICAL-PHYSICAL PROBLEM OF P PRIME(f) TO N(h) INVERSION FOR ANISOTROPIC MEDIA c13
A. K. Paul *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 13 p (For availability see N73-11585 02-19)
CSCL 04A

The requirements for a numerical inversion method to calculate electron density profiles from ionograms are discussed. A systematic investigation about the independence of the two magnetoionic components shows that the extent to which the range of ambiguity can be reduced depends mainly on the magnetic latitude. Error estimates and first-order corrections for less elaborate methods are included. Author

N73-11606* National Oceanic and Atmospheric Administration, Boulder, Colo.
AUTOMATIC N(h,t) PROFILES OF THE IONOSPHERE WITH A DIGITAL IONOSONDE c13
J. W. Wright, A. R. Laird, E. J. Violette, D. McKinnis, and D. Obitts *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p (For availability see N73-11585 02-19)
CSCL 04A

A method is described to accomplish automatic data selection and profile inversion to obtain ionospheric electron density profiles from digitized radio soundings. The profile inversion is based on a well-established formulation by which the optimum radio frequency sounding intervals can be specified from an approximate knowledge of the profile; the expected virtual height coordinates (h) at these frequencies (f) are estimated, and procedures are then used to select h(f) observations nearest the predicted coordinates from a subsequent digital ionogram. From these the next profile is obtained. The process adaptively follows the changing shape and detail of the profile. The procedure requires an average of 15 sec per profile on a standard data processing computer, and can be adapted, with benefit to online real-time use in a digital ionosonde. Author

N73-11607* Stanford Research Inst., Menlo Park, Calif.
IONOSPHERIC PROFILE INVERSION USING OBLIQUE-INCIDENCE IONOGRAMS c13
D. L. Nielson and T. M. Watt *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 12 p (For availability see N73-11585 02-19)
CSCL 04A

Some of the elementary methods used in deriving true-height profiles from oblique-incidence ionograms are reviewed. The two principal methods presented are oblique-to-vertical transformation and direct inversion of the oblique-incidence ionogram. Limitations in oblique-incidence inversion due to magnetic-field effects, horizontal gradients, and absolute time delay are discussed. Author

N73-11608* Indiana Univ., Bloomington.
INTRODUCTION TO THE INVERSE QUANTUM SCATTERING PROBLEM
Roger G. Newton *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 12 p Sponsored in part by NSF and Army (For availability see N73-11585 02-19)
CSCL 12A

The inverse scattering problem is introduced in the context of the Schroedinger equation. The emphasis is on the Gelfand Levitan approach to the nonrelativistic problem at fixed angular momentum. Author

N73-11609* Montpellier Univ. (France).
REVIEW OF THE INVERSE SCATTERING PROBLEM AT FIXED ENERGY IN QUANTUM MECHANICS
Pierre C. Sabatier *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 19 p (For availability see N73-11585 02-19)
CSCL 12A

Methods of solution of the inverse scattering problem at fixed energy in quantum mechanics are presented. Scattering experiments of a beam of particles at a nonrelativisitic energy by a target made up of particles are analyzed. The Schroedinger equation is used to develop the quantum mechanical description of the system and one of several functions depending on the relative distance of the particles. The inverse problem is the construction of the potentials from experimental measurements. Author

N73-11610* Rome Univ. (Italy).
EXPLICIT EXPRESSIONS OF THE POTENTIAL AND ITS DERIVATIVES AT THE ORIGIN IN TERMS OF THE SCATTERING DATA
F. Calogero *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 48 p Prepared in cooperation with Ist. Nazl. di Fis. Nucl., Rome, Italy (For availability see N73-11585 02-19)
CSCL 12A

The quantum mechanical theory of scattering of a particle by a spherically symmetrical potential is presented. As in the inverse scattering problem, the input of the calculation is the scattering and bound-state data, and the output is data on the potential. The results discussed are explicit expressions for the values of the potential and its derivatives at the origin in terms of the scattering and boundstate data. Various methods to obtain these results are outlined. The presentation is aimed at introducing these various approaches. The simplest scattering problem (nonrelativistic S-wave scattering on a holomorphic potential without bound states) is used as the basis for discussion, and technicalities are omitted whenever possible without loss of clarity. A complete compilation is given of the results obtained to date in this field, including the treatment of higher partial waves and the Klein-Gordon and Dirac equations. Author

N73-11611* Laboratoire de Physique Theorique et Particules Elementaires, Orsay (France).
THE INVERSE SCATTERING PROBLEM AT FIXED ANGULAR MOMENTUM FOR NONLOCAL SEPARABLE INTERACTIONS
K. Chadan *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 13 p (For availability see N73-11585 02-19)
CSCL 12A

The problem of inverse scattering at fixed angular momentum is considered. The problem is particularized to the case of nonlocal separable interactions. A brief survey of the inverse problem for nonlocal separable interactions is presented. This problem can be solved exactly by integration. It amounts to solving singular integral equations of the Hilbert-Mushkhelishvili type, which have been studied extensively in the past and appear in many areas of physics, including theory of elasticity and dispersions relations in high energy physics. Author

N73-11612* Wayne State Univ., Detroit, Mich.
THE INVERSE SCATTERING PROBLEM FOR TRANSMISSION LINES c10
Irvin Kay *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 16 p (For availability see N73-11585 02-19)
CSCL 09C

A number of exact and approximate methods for solving the inverse scattering problem for transmission lines are reviewed. In particular, the application to transmission lines of Marcenko's version of the Gelfand-Levitan exact method for the quantum mechanical problem is compared with a more direct approach based on a different version of the Gelfand-Levitan method. In addition, some aspects of the lack of uniqueness of solutions are discussed, and some open questions related to the inverse scattering problem are suggested. Author

N73-11613* Dartmouth Coll., Hanover, N.H.
THE INVERSE PROBLEM FOR RADIATION SCATTERING
Reese T. Prosser *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
CSCL 12A

A brief survey of recent theoretical progress on the inverse scattering problem for radiation scattering from reflective boundaries and variable indices of refraction. The theory of radiation scattering is concerned primarily with the far-field relations between incident and scattered radiation in the presence of a scattering object. The primary, or direct, problem of this theory is to develop quantitative information about these scattering relations from a knowledge of the scattering object. The secondary, or inverse, problem, on the other hand, is to determine the nature of the object from an analysis of the scattering relations. Author

N73-11614* Polytechnic Inst. of Brooklyn, N.Y.
DIAGNOSTICS OF NONRADIALLY STRATIFIED MEDIA
J. Shmoys and J. A. Pirraglia *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 6 p (For availability see N73-11585 02-19)
(Grant NGR-33-006-047; Contract AT(30-1)-3956)
CSCL 12A

The diagnostics of nonradially stratified media are presented. The analysis is applied to distributions lacking spherical symmetry. It is assumed that the medium is thin enough so that the ray remains rectilinear. The data to be used consists of the change in phase of a wave propagated along a ray due to the presence of the medium, for a given set of rays. Two dimensional and three dimensional distributions are considered. Author

N73-11615* Bojarski (Norbert N.) Moorestown, N.J.
ELECTROMAGNETIC INVERSE SCATTERING c07
Norbert N. Bojarski *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 14 p (For availability see N73-11585 02-19)
(Contracts AF 30(602)-3961; F30602-68-C-0260)
CSCL 20N

A three-dimensional electromagnetic inverse scattering identity, based on the physical optics approximation, is developed for the monostatic scattered far field cross section of perfect conductors. Uniqueness of this inverse identity is proven. This identity requires complete scattering information for all frequencies and aspect angles. A nonsingular integral equation is developed for the arbitrary case of incomplete frequence and/or aspect angle scattering information. A general closed-form solution to this integral equation is developed, which yields the shape of the scatterer from such incomplete information. A specific practical radar solution is presented. The resolution of this solution is developed, yielding short-pulse target resolution radar system parameter equations. The special cases of two- and one-dimensional inverse scattering and the special case of a priori knowledge of scatterer symmetry are treated in some detail. The merits of this solution over the conventional radar imaging technique are discussed. Author

N73-11616* Purdue Univ., Lafayette, Ind.
SOME SPECIAL CASES OF THE ELECTROMAGNETIC INVERSE PROBLEM c07
V. H. Weston *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p refs (For availability see N73-11585 02-19)
CSCL 20N

A review of exact techniques for determining the surface of a three-dimensional perfectly conducting body is given, followed by some new results on the uniqueness question concerning the number of measurements that may be required to explicitly determine the surface of the body. It is then shown that the inhomogeneous but spherically symmetric dielectric electromagnetic case is reducible to a scalar inverse problem that can be treated by known techniques. Author

N73-11617* Toronto Univ. (Ontario).
MONTE CARLO INVERSION OF SEISMIC DATA
Ralph A. Wiggins *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 8 p (For availability see N73-11585 02-19)
CSCL 12A

The analytic solution to the linear inverse problem provides estimates of the uncertainty of the solution in terms of standard deviations of corrections to a particular solution, resolution of parameter adjustments, and information distribution among the observations. It is shown that Monte Carlo inversion, when properly executed, can provide all the same kinds of information for nonlinear problems. Proper execution requires a relatively uniform sampling of all possible models. The expense of performing Monte Carlo inversion generally requires strategies to improve the probability of finding passing models. Such strategies can lead to a very strong bias in the distribution of models examined unless great care is taken in their application. Author

N73-11618* California Univ., San Diego.
BACKUS-GILBERT INVERSION OF TRAVEL TIME DATA
Leonard Evans Johnson *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p (For availability see N73-11585 02-19)
(Grant NSF GA-1225)
CSCL 12A

Application of the Backus-Gilbert theory for geophysical inverse problems to the seismic body wave travel-time problem is described. In particular, it is shown how to generate earth models that fit travel-time data to within one standard error and having generated such models how to describe their degree of uniqueness. An example is given to illustrate the process. Author

N73-11619* California Univ., San Diego.
THE BACKUP-GILBERT METHOD AND ITS APPLICATION TO THE ELECTRICAL CONDUCTIVITY PROBLEM c10
Robert L. Parker *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 8 p (For availability see N73-11585 02-19)
CSCL 09C

The theory of Backus and Gilbert gives a technique for solving the general linear inverse problem. Observational error and lack of data are shown to reduce the reliability of the solution in different ways: the former introduces statistical uncertainties in the model, while the latter smooths out the detail. Precision can be improved by sacrificing resolving power, and vice versa, so that some compromise may be made between the two in choosing the best model. Nonlinear inverse problems can be brought into the domain of the theory by linearizing about a typical solution. The inverse problem of electrical conductivity in the mantle is used to illustrate the Backus-Gilbert technique; an example of the tradeoff diagram is given. Author

N73-11620* California Univ., San Diego.
CULLING OF REDUNDANT DATA
Freeman Gilbert *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 7 p (For availability see N73-11585 02-19)
CSCL 12A

The inversion of a large data set, with it errors, is demonstrated and the tradeoff curve, or resolving power calculations, are discussed. Consideration is given to inverse problems of the earth, represented in the idealized form of a single scaler function of a single coordinate. The difference between the functional for the real earth and the functional for some model is formulated.

A procedure is given for using the linear relationships between the differences in the data and the differences in the model as side conditions. Through a process of diagonalization a model is created that fits the data. The data are culled by accepting only those relative standard errors that are less than 100 percent.
D.L.G.

N73-11621* California Inst. of Tech., Pasadena.
APPLICATION OF A STOCHASTIC INVERSE TO THE GEOPHYSICAL INVERSE PROBLEM
Thomas H. Jordan and J. Bernard Minster *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 12 p refs (For availability see N73-11585 02-19)
(Contract F44620-69-C-0067)
CSCL 12A

The inverse problem for gross earth data can be reduced to an undertermined linear system of integral equations of the first kind. A theory is discussed for computing particular solutions to this linear system based on the stochastic inverse theory presented by Franklin. The stochastic inverse is derived and related to the generalized inverse of Penrose and Moore. A Backus-Gilbert type tradeoff curve is constructed for the problem of estimating the solution to the linear system in the presence of noise. It is shown that the stochastic inverse represents an optimal point on this tradeoff curve. A useful form of the solution autocorrelation operator as a member of a one-parameter family of smoothing operators is derived. Author

N73-11622* Illinois Univ., Urbana.
SOME METHODS FOR DETERMINING THE PROFILE FUNCTIONS OF INHOMOGENEOUS MEDIA
R. Mittra, D. H. Schaubert, and M. Mostafavi *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 11 p refs (For availability see N73-11585 02-19)
CSCL 12A

The problem of determining the electric permittivity of an inhomogeneous dielectric medium is considered. Two analytical methods and one numerical method for solving this problem are presented. All these methods utilize the reflection coefficient measured as a function of the angular spectrum variable. This allows measurements at a fixed frequency, and these methods, therefore, can be used when the medium being studied is dispensive. A few examples are provided and some comments are made regarding the stability of solutions obtained using the various methods. Author

N73-11623* Bojarski (Norbert N.) Moorestown, N.J.
THE K-SPACE FORMULATION OF THE n-DIMENSIONAL SCATTERING PROBLEM
Norbert N. Bojarski *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 13 p refs (For availability see N73-11585 02-19)
(Contract F33615-70-C-1345)
CSCL 12A

The n-dimensional scattering problem is solved by means of a k-space formulation of the field equations, thereby replacing the conventional integral equation formulation by a set of two algebraic equations in two unknowns in two spaces (the constitutive equation being an algebraic equation in x-space). These equations are solved by an iterative method with the aid of the fast Fourier transform (FFT) algorithm connecting the two spaces, requiring very simple initial approximations. Since algebraic and FFT equations are used, the number of arithmetic multiple-add operations and storage allocations required for a numerical solution are reduced from the order of N sq (for solving the matrix equations resulting from the conventional integral equations) to the order of N(log base 2 of N) and N, respectively (where N is the number of data points required for the specification of the problem). The advantage gained in speed and storage is thus of the order of N/log base 2 of N and N, respectively. This method is thus considerably more efficient than the conventional matrix method, and permits exact numerical solutions for much larger problems. Arguments are presented toward the view that the field equations are more fundamental in k-space. The details and some numerical results of the application of this method to the three-dimensional electromagnetic scattering problems are presented as an example. Author

N73-11624* Illinois Univ., Urbana.
INVERSION OF RADIATION DATA IN BIOPHYSICS
Victor Twersky *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 4 p refs (For availability see N73-11585 02-19)
CSCL 12A

Topics in biophysics are summarized in which radiation data inversion problems occur. The topics fall into two main categories. The first relates to information acquired about the distance environment through seeing, hearing, etc. The second relates to the use of electromagnetic, acoustic, or other radiation for diagnostic purposes, either at a bulk or a molecular level.
Author

N73-11625* Bell Telephone Labs., Inc., Murray Hill, N.J.
TRANSMISSION LINE INVERSION AND SYNTHESIS FROM THE POINT OF VIEW OF TRANSIENT RESPONSE c10
M. M. Sondhi *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 7 p refs (For availability see N73-11585 02-19)
CSCL 09C

The transmission line inversion problem is applied to the speech communication process. The problem involves acquiring information necessary for synthesis of speech and for making models of the speech production mechanism. Formulation for the problem is derived from an analysis of the human vocal tract functions. It is known that speech sounds are produced by acoustic excitation of the tract by means of quasi-periodic pulses from the vocal cords during vowel sounds and turbulent air flow at various points along the tract during fricative sounds. By assuming plane wave propagation, differential equations are obtained relating the cross sectional area of the tract, the pressure, and the volume velocity. By replacing the pressure factor with a voltage factor and the volume velocity by current, the problem becomes a transmission line problem. D.L.G.

N73-11626* Naval Electronics Lab. Center, San Diego, Calif.
THE INVERSION OF VLF-LF SOUNDER DATA TO OBTAIN D-REGION ELECTRON-DENSITY DISTRIBUTIONS c13
C. H. Shellman *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 7 p refs (For availability see N73-11585 02-19)
CSCL 04A

The direct problem is to compute reflection coefficients for an assumed electron-density profile, using a full-wave solution. The inverse problem is treated numerically, using derivatives of the reflection matrix with respect to model parameters. A technique for the rapid computation of the derivatives is described. An algorithm for determining resolution in the profile is discussed.
Author

N73-11627* Dartmouth Coll., Hanover, N.H.
THE JOST-KOHN INVERSION PROCEDURE
Reese T. Prosser *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 6 p (For availability see N73-11585 02-19)
CSCL 12A

Conditions are considered that must be imposed on a class of quantum mechanical problems to obtain reasonable results by the Jost-Kohn procedure. The discussion is restricted to problems in three space-dimensions without assuming any radial or other symmetry of the potential. Author

N73-11628* New York Univ., N.Y.
THE LOCATION OF THE POLES OF THE SCATTERING MATRIX
Peter D. Lax and Ralph S. Phillips (Stanford Univ.) *In* NASA. Ames Research Center Math. of Profile Inversion Aug. 1972 6 p refs (For availability see N73-11585 02-19)
CSCL 12A

A number of recent results bearing on the direct problem are described. The results deal with exterior problems and relate geometric properties of the scattering obstacles to analytic properties of the associated scattering matrix. Author

N73-11629* Montpellier Univ. (France).
COMPARATIVE EVOLUTION OF THE INVERSE PROBLEMS (INTRODUCTION TO AN INTERDISCIPLINARY STUDY OF

THE INVERSE PROBLEMS)
Pierre C. Sabatier *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 33 p refs (For availability see N73-11585 02-19)
CSCL 12A

The progressive realization of the consequences of nonuniqueness imply an evolution of both the methods and the centers of interest in inverse problems. This evolution is schematically described together with the various mathematical methods used. A comparative description is given of inverse methods in scientific research, with examples taken from mathematics, quantum and classical physics, seismology, transport theory, radiative transfer, electromagnetic scattering, electrocardiology, etc. It is hoped that this paper will pave the way for an interdisciplinary study of inverse problems. Author

N73-11630* Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Long Island Graduate Center.
ADDITIONAL COMMENTS CONCERNING INVERSION TECHNIQUES
J. Shmoys *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 3 p refs (For availability see N73-11585 02-19)
CSCL 12A

The chronological development of multidimensional inversion techniques is reviewed briefly. Some current work in this area is described. Author

N73-11631# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
SCATTERING MATRIX AND DOUBLING EQUATIONS FOR THE SCATTERING AND TRANSMISSION FUNCTIONS
P. T. Poon and S. Ueno Sep. 1972 15 p refs
(Contract AT(40-3)-113; Grant NSF GP-29049; Proj. 19)
(USC-113P19-32; TR-72-51) Avail: NTIS HC $3.00

The doubling equations for the scattering and transmission functions for a homogeneous isotropically scattering atmosphere are derived. Author

N73-11632# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
SUCCESSIVE APPROXIMATIONS AND DYNAMIC PROGRAMMING
Art Lew Aug. 1972 17 p refs
(Grant NSF GP-29049)
(TR-72-43) Avail: NTIS HC $3.00

A number of successive approximation techniques for solving the discrete Bolza problem by means of dynamic programming are surveyed. A generalized approach involving approximations to both the criterion function and the state equation is then described. This approach, which may be characterized as a prediction-correction one, is related to earlier techniques. Author

N73-11633# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
STABILITY, PREDICTION-CORRECTION, AND DYNAMIC PROGRAMMING
A. Lew Aug. 1972 20 p refs
(Contract AT(40-3)-113; Grant NSF GP-29049)
(USC-113P19-28; TR-72-46) Avail: NTIS HC $3.00

A bounded perturbation of the discrete dynamic programming functional equation arising from the Bolza problem yields a bounded change in its solution. This stability property encourages the development of approximation techniques for solving such equations. One such technique, involving the backward solution of an approximate functional equation as a prediction step followed by a forward reconstruction using true equations as a correction step, is discussed. Bounds for the errors arising out of such an approximation procedure are derived. Finally, numerical results are given illustrating applicability to the optimal control of time-lag control processes. Author

N73-11634# University of Southern Calif., Los Angeles. Dept. of Electrical Engineering.
FACTORIZATION AND IMBEDDING FOR GENERAL LINEAR BOUNDARY VALUE PROBLEMS
Alex McNabb and Alan Schumitzky Sep. 1972 48 p refs
(Grant GM-16197-04)
(TR-72-48) Avail: NTIS HC $4.50

A new direction in the theory of general linear boundary value problems is explored. The starting point is an explicit Volterra factorization of the Green's matrix (and related kernels) associated with the problem. This result leads to imbedding of the boundary value problems, initial value algorithms for their solution, and comparison theorems relating two different boundary value problems with a common boundary condition. Extensions and connections with earlier work are presented. Author

N73-11635# University of Southern Calif., Los Angeles.
DYNAMIC PROGRAMMING AND BICUBIC SPLINE INTERPOLATION
R. Bellman, B. Kashef, and R. Vasudevan Sep. 1972 24 p refs
(Contract AT(40-3)-113; Grant NSF GM-16197-05)
(USC-113P19-33; TR-72-52) Avail: NTIS HC $3.25

Dynamic programming techniques were used to arrive at the spline approximation for a function with prescribed values on the knot points along a line. Extending this procedure to two dimensions, the bicubic spline approximation defined over a two dimensional region is obtained employing the methods of dynamic programming. A regular rectangular region as well as a region with irregular boundaries can be handled by this method, avoiding the difficulties of large storage and high dimensionality. Author

N73-11636*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CRITERIA FOR THE OPTIMAL DESIGN OF EXPERIMENTAL TESTS
George C. Canavos Washington Nov. 1972 27 p refs
(NASA-TM-X-2663; L-8504) Avail: NTIS HC $3.00 CSCL 12A

Some of the basic concepts are unified that were developed for the problem of finding optimal approximating functions which relate a set of controlled variables to a measurable response. The techniques have the potential for reducing the amount of testing required in experimental investigations. Specifically, two low-order polynomial models are considered as approximations to unknown functionships. For each model, optimal means of designing experimental tests are presented which, for a modest number of measurements, yield prediction equations that minimize the error of an estimated response anywhere inside a selected region of experimentation. Moreover, examples are provided for both models to illustrate their use. Finally, an analysis of a second-order prediction equation is given to illustrate ways of determining maximum or minimum responses inside the experimentation region. Author

N73-11637# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.
A HEURISTIC ALGORITHM FOR INTEGER LINEAR PROGRAMMING PROBLEMS
E. R. Brocklehurst Jun. 1972 21 p refs
(NPL-NAC-18) HC $3.25

An approximate solution to the integer linear programming problem is one that is an integer, satisfies the problem's constraints, and has an objective function value close to that of the optimal solution. A procedure which attempts to find approximate solutions in a small fraction of the time required to solve the associated continuous problem is described. It may be used either by itself, or to provide a starting point for optimal algorithms. The extension of the method to the mixed integer linear programming problem is discussed, and computational results reported. Author (ESRO)

N73-11638# National Physical Lab., Teddington (England). Div. of Numerical Analysis and Computing.
THE SIMPLEX METHOD: ITS STATEMENT IN STANDARD ALGEBRAIC TERMS AND THOSE OF LINEAR PROGRAMMING
E. R. Brocklehurst Jul. 1972 12 p ref
(NPL-NAC-19) Avail: NTIS HC $3.00

The simplex method for solving linear programming problems is often described in terms of the inverse matrix method and the use of slack variables. This approach is not always readily

understood by workers in other branches of mathematics, who seek a description in terms of the standard concepts of linear algebra. The simplex method is described from both points of view and a correspondence is established between the respective terminologies. Author (ESRO)

N73-11639# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et de ses Applications Spatiales.

STUDY OF BIFURCATIONS RELATED, FOR A SECOND ORDER RECURRENCE, TO THE PASSING THROUGH A CRITICAL CASE CORRESPONDING TO A REAL MULTIPLIER OF A MODULUS EQUAL TO ONE [ETUDE, POUR UNE RECURRENCE DU SECOND ORDRE, DES BIFURCATIONS LIEES A LA TRAVERSEE D'UN CAS CRITIQUE CORRESPONDANT A UN MULTIPLICATEUR REEL EGAL A 1 EN MODULE]

F. Roubellat 1972 24 p refs In FRENCH; ENGLISH summary (LAAS-Publ-934) Avail: NTIS HC $3.25

Certain qualitative aspects of the sensitivity problem in relation to small parameter variations of a system, the behavior of which can be described by an autonomous second order relation with real variables, is considered. Such equations define a point transformation which when repeated leads to a discrete trajectory in the plane. Some results are given concerning qualitative changes, also called bifurcations, which take place when the parameter varies near a special value such that one of the roots (mutliplier) of the characteristic equation, defined for a fixed point, takes the value + or - 1. The modulus of the other root is smaller than unity. The special value is a bifurcation value that corresponds to a critical case in the Liapunov sense.

Author (ESRO)

N73-11640# Centre National de la Recherché Scientifique, Toulouse (France). Lab. d'Automatique et de ses Applications Sepatiales.

STOCHASTIC SOLUTIONS IN A CONSERVATIVE DYNAMIC SYSTEM

C. Mira and I. Gumowski (CERN) 1972 18 p refs
(LAAS-Publ-935) Avail: NTIS HC $3.00

Solutions of autonomous fourth order conservative dynamic systems, or second order nonautonomous dynamic systems, with periodic coefficients can be described by an autonomous second order point mapping (a second order recurrence or surface transformation). The recurrence considered arises in the study of particle dynamics in accelerators and storage rings. In order to determine the qualitative behaviour of the solutions, some of which are stochastic in the (x sub n, y sub n) plane, the properties and the distribution of the cycles (periodic points) are described. Several regular features can be discerned. Intersecting invariant curves passing through saddle-type fixed points or cycles are then computed and homoclinic or heteroclinic points are defined. The following structure of solutions appears: a center surrounded by a set of regular closed trajectories (free of singularities), one or more island structures and one or more instability rings. However, this solution structure is not sufficient to account for all features. At least two new features appear: a region of diffusion and a region of stochastic instability. Author (ESRO)

N73-11641# Ruhr Univ., Bochum (West Germany). Abteilung fuer Mathematik.

THE PRINCIPLE OF MIQUEL IN THE PSEUDO-EUCLIDIAN (MINKOVICH) GEOMETRY Ph.D. Thesis [DER SATZ VON MIQUEL IN DER PSEUDO-EUKLIDISCHEN (MINKOWSKISCHEN) GEOMETRIE]

Gerd Franz Friedrich Kaerlein 9 Nov. 1970 91 p refs In GERMAN
Avail: NTIS HC $6.75

A singular chain geometry is developed from the complete Miquel theorem and used to formulate a generalized Miquel theorem. The generalized formulation is then applied for algebraisation of the pseudo-Euclidian Minkowsky geometry.

Transl. by G.G.

N73-11642# Mitsubishi Heavy-Industries, Ltd., Tokyo (Japan).

VARIATIONAL PRINCIPLE OF LINEAR DIFFERENTIAL EQUATIONS

Tsutomu Fujino Mar. 1972 28 p refs
(PB-210374; MTB-77) Avail: NTIS HC $3.00 CSCL 12A

A study on the variational principle of various self adjoint as well as non self adjoint linear differential equations of real numbers is presented. GRA

N73-11643# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Directorate.

DISTURBANCE ACCOMMODATION IN LINEAR SYSTEMS WITH CHATTERING CONTROLLERS

Kelly V. Grider 18 May 1972 111 p refs
(DA Proj. 1X2-63302-D-212)
(AD-745896; RG-TR-72-10) Avail: NTIS CSCL 12/1

The report is concerned with the development of a theory of disturbance accommodating regulators, using a bang-bang controller operating in the chatter mode. Author (GRA)

N73-11644# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SHORTWAVE PROPAGATION IN A MEDIUM WITH RANDOM HETEROGENEITIES IN APPROXIMATE MARKOVIAN RANDOM PROCESS

V. I. Tatarskii 22 Apr. 1972 124 p refs Transl. into ENGLISH from the Monograph "Rasprostranenie Korotkikh Voln v Srede so Sluchainymi Neodnorodnostyamiw Privlizhenii Markovskogo Sludchainogo Protsessa" Moscow, 1970 125 p
(AF Proj. 1279)
(AD-746714; FTD-HT-23-444-72) Avail: NTIS CSCL 12/1

A survey of existing theoretical methods for studying the propagation of waves in continuous randomly inhomogeneous media is given. The methods are explained and evaluated using a simple example of a stochastic wave equation. The method of small perturbations is outlined, and attention is given to approximate methods which generalize the geometrical optics approximation and are used in cases of large scale inhomogeneities. The method of smooth disturbances and the parabolic equation method are also examined, including the Markov approximation in the latter procedure. A brief review of the results obtained with these methods is given, and their validity is evaluated. The main problems and results of the current theory of multiple scattering are analyzed. This theory is based on partial summation of perturbation theory series and leads to Dyson and Bethe Salpeter type equations. Author (GRA)

N73-11645# Texas Univ., Austin. Center for Cybernetic Studies.

CONSTRAINED n-PERSON GAMES

A. Charnes and S. Sorensen Jan. 1972 20 p refs
(Contracts N00014-67-A-0126-0008;
N00014-67-A-0126-0009; NR Proj. 047-021)
(AD-746553; CS-69) Avail: NTIS CSCL 12/2

The paper is one of a series in which external principles are employed to develop new classes of games and/or notions of solution. Herein extension from two-person games and the study of properties of constrained n-person games is begun. An extremal (linear programming) principle method is developed to calculate the characteristic function for the normal form of such n-person games. Theorems giving the properties of the characteristic function follow immediately from the formulation. The linear programs can include constraints on the strategies of individual players or coalitions. Interestingly, the characteristic function resulting from such a constrained game is not necessarily superadditive. The core-stem (hierarchical) notions and the convex-nucleus notions seem to be the most promising (other standard ones are not applicable) for developing solution notions for such constrained n-person games. Author (GRA)

N73-11646# Stanford Univ., Calif. Dept. of Mathematics.

A NOTE ON PROBLEMS OF WAVE GENERATION IN SEMI-INFINITE MEDIA BY SURFACE FORCES

Harold Levine 1 Aug. 1972 24 p refs
(Contract N00014-67-A-0112-0048)
(AD-746897; SU-TR-19) Avail: NTIS CSCL 12/1

A classical problem of unsteady wave excitation, which envisages loading or primary sources on the boundary of a half-space, is resolved in a direct and efficient fashion, yielding various theoretical representations of the solution and unifying previously reported analyses. Author (GRA)

N73-11647# Denver Univ., Colo. Dept. of Mathematics.
ASYMPTOTIC METHODS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS WITH APPLICATION TO ENERGY PROPAGATION IN FLUID DYNAMICS Final Report
N. Bleistein 15 Aug. 1972 12 p refs
(Grant AF-AFOSR-1923-70; AF Proj. 9749)
(AD-747280; DU-MS-7102; AFOSR-72-1597TR) Avail: NTIS CSCL 12/1

The report contains three sections on research progress: Analysis of internal waves in an inhomogeneous fluid; Bifurcation in regular and singular eigenvalue problems; Asymptotic expansion of integrals. Author (GRA)

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N73-11648 Meteorological Office (Gt. Brit.).
BRITISH ISLES WEATHER TYPES AND A REGISTER OF THE DAILY SEQUENCE OF CIRCULATION PATTERNS, 1861 - 1971
H. H. Lamb 1972 89 p refs
(Met.O.845b) Copyright. Avail: HMSO £3; PHI $11.63

The circulation pattern over the British Isles region, taken as approximating to the square 50 to 60 deg N and 10 deg W to 2 deg E, is defined in terms of seven types: anticyclonic, cyclonic, westerly, northwesterly, northerly, easterly, and southerly. The definitions are designed for recognition on surface maps of pressure distribution, winds and weather, but are more concerned to indicate the evolution and steering of the circulation systems from day to day and over periods of several successive days, or longer. Methods used and problems encountered in making and interpreting the classification are explained. Author

N73-11649 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie.
METEOROLOGICAL DATA. VOLUME 127, NO. 1: WIND EVALUATION FROM SATELLITE PHOTOGRAPHY [METEOROLOGISCHE ABHANDLUNGEN. BAND 127, HEFT 1: WINDADSCHAETZUNGEN AUS SATELLITENFOTOS]
Friedrich-Wolf Hodeck 1972 84 p refs In GERMAN; ENGLISH summary
Avail: Issuing Activity

Methods are discussed which are used to derive air motions for satellite pictures, and photogrammetrical problems are described in mathematical terms. The main idea is the demonstration of fundamental problems which become relevant for a real quantitative interpretation of satellite pictures. In this respect the physical process of picture-formation and the possibility to define three-dimensional coordinates from photos is important. These two questions are investigated with reference to satellite pictures in a mathematical model as well as in the physical way. Author

N73-11650 Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie.
METEOROLOGICAL DATA, VOLUME 122, NO. 11: AEROLOGICAL DATA, BERLIN-TEMPELHOF, NOVEMBER 1971 [METEOROLOGISCHE ABHANDLUNGEN. BAND 122, HEFT 11: AEROLOGISCHE DATEN, BERLIN-TEMPELHOF, NOVEMBER 1971]
Nov. 1971 159 p refs In GERMAN; ENGLISH summary
Avail: Issuing Activity

The detailed results of the radiosonde ascents performed by the aerological station of the Institut fur Meteorologie der Freien Universitat Berlin are presented. Extreme and mean values of the temperature, pressure, geopotential, wind data, refractivity, pseudopotential temperature and velocity of sound, were extracted for all standard pressure surfaces, several height levels the tropopause and the freezing level. The temperature curve of the climatological mean and the data of the ozone-ascents are presented in tabular and graphical form. Author

N73-11651 International Geophysical Year World Data Center A, Asheville, N.C.
HIGH ALTITUDE METEOROLOGICAL DATA, VOLUME 8, NO. 1
Jan. 1971 304 p refs
Avail: National Climatic Center, Federal Building, Attention: Publications, Asheville, N. C. 28801

Wind and temperature measurements from all available meteorological sounding rocket firings are presented along with the computed values for pressure, density, and speed of sound. Local radiosonde observations nearest the time of firing are included. Statistical tables and graphs of current month means, and standard deviations for all parameters with long-term means are also presented. Author

N73-11652 International Geophysical Year World Data Center A, Asheville, N.C.
HIGH ALTITUDE METEOROLOGICAL DATA, VOLUME 8, NO. 2, FEBRUARY 1971
1972 238 p
Avail: National Climatic Center, Federal Building, Asheville, N. C. 28801. Attn: Publications $3.00

Wind and temperature measurements from all available meteorological sounding rocket firings are presented, along with computed values for pressure, density, and speed of sound. Local radiosonde observations nearest the time of firing are included. Statistical tables and graphs of current month means and standard deviations for all parameters with long term means are also presented. Author

N73-11653*# Iowa State Univ. of Science and Technology, Ames.
APPLICATION OF CONSERVATIVE FINITE-DIFFERENCE METHODS TO ADVECTION PROBLEMS M.S. Thesis
Behrooz Fattahi 1971 43 p refs
(Grant NGR-16-002-029)
(NASA-CR-129090) Avail: NTIS HC $4.25 CSCL 04B

The possibility of applying the most recent conservative and widely applied numerical techniques in gas dynamics to problems encountered in meteorological computations is investigated. Solutions of the advection equation are obtained using conservative differencing methods. These results are compared to those obtained by differencing the advection equation directly. The comparison shows that better results are obtained when the conservative form of governing equation is used. In addition, better results are obtained with lower order conservative methods as compared with higher order differencing applied to the advection equation. Author

N73-11654# Bureau of Meteorology, Melbourne (Australia).
MONTHLY CLIMATE DATA, UPPER AIR AUSTRALIA, JANUARY 1972
Jan. 1972 18 p refs
Avail: NTIS HC $3.00

Monthly mean meteorological statistics for specified levels from the surface to 5 mb for January 1972 are tabulated. The statistics include geopotential, atmospheric temperature, humidity (mixing ratios), and wind direction and speed. Author

N73-11655# Bureau of Meteorology, Melbourne (Australia).
MONTHLY CLIMATE DATA, UPPER AIR AUSTRALIA, NOVEMBER 1971
Nov. 1971 18 p refs
Avail: NTIS HC $3.00

Meteorological statistics are presented for the upper atmosphere in the Australian region. The statistics are derived from upper atmosphere wind, temperature and humidity observations made daily at a number of stations operated by the Bureau of Meteorology. Author

N73-11656# Research Inst. of National Defence, Stockholm (Sweden).
COMPUTER PROGRAM FOR CALCULATION OF GEOSTROPHIC TRAJECTORIES [DATORPROGRAM FOER BERAEKNING AV GEOSTROFISKA TRAJEKTORIER]
A. Ekroth Jul. 1971 58 p refs In SWEDISH
(FOA-4-C-4469-A1) Avail: NTIS HC $5.00

A method and program are described for calculating

geostrophic trajectories. The calculation is based on information about topography of an isobar contour and can be done either forwards or backwards in time for up to 99 simultaneous trajectories. Input and output data are specified so that calculations can be made to continue on from the trajectories end point. The program is written in FORTRAN 4 for the IBM 7090 computer. Author

N73-11657*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEASUREMENTS OF THE STRUCTURE AND CIRCULATION OF THE STRATOSPHERE AND MESOSPHERE, 1970
W. S. Smith, J. S. Theon, D. U. Wright, Jr., J. F. Casey (Globe Universal Sciences, Inc.), and J. J. Horvath (Michigan Univ.) Washington Nov. 1972 56 p refs
(NASA-TR-R-391; G-1078) Avail: NTIS HC $3.00 CSCL 04B

Complete data from a total of 26 meteorological rocket soundings of the stratosphere and mesosphere conducted from Barrow, Alaska; Churchill, Canada; and Wallops Island, Va., are presented. These data consist of temperature, pressure, density, and wind profiles from 16 acoustic grenade soundings that cover the 30- to 90-km altitude range, and temperature, pressure, and density profiles from 10 pitot probe soundings that cover the 25- to 120-km altitude range. Errors for each of the 16 grenade soundings are also included. No analysis of the meteorological significance of the data is attempted. Author

N73-11658*# Westinghouse Research Labs., Pittsburgh, Pa.
LIGHTNING CRITERIA RELATIVE TO SPACE SHUTTLES: CURRENTS AND ELECTRIC FIELD INTENSITY IN FLORIDA LIGHTNING
Martin A. Uman and D. Kenneth McLain Washington NASA Nov. 1972 42 p refs
(Contracts NAS8-28168; NAS9-11629; N00014-71-C-0005; N00014-68-A-0173-0018; Grant NSF GA-31976)
(NASA-CR-2161; M106) Avail: NTIS HC $3.00 CSCL 04B

The measured electric field intensities of 161 lightning strokes in 39 flashes which occurred between 1 and 35 km from an observation point at Kennedy Space Center, Florida during June and July of 1971 have been analyzed to determine the lightning channel currents which produced the fields. In addition, typical channel currents are derived and from these typical electric fields at distances between 0.5 and 100 km are computed and presented. On the basis of the results recommendations are made for changes in the specification of lightning properties relative to space vehicle design as given in NASA TMX-64589 (Daniels, 1971). The small sample of lightning analyzed yielded several peak currents in the 100 kA range. Several current rise-times from zero to peak of 0.5 microsec or faster were found; and the fastest observed current rate-of-rise was near 200 kA/microsec. The various sources of error are discussed. Author

N73-11659# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION, SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Dec. 1971 [POLLUTION ATOMSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX BULLETIN MENSUEL, DECEMBRE 1971]
Dec. 1971 28 p In FRENCH and DUTCH Prepared in cooperation with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS HC $3.50

Data obtained at Belgian weather stations are tabulated. The air pollution apparatus is briefly described. ESRO

N73-11660# Environmental Prediction Research Facility (Navy), Monterey, Calif.
NUMERICAL MODELING OF THE GROWTH OF ICE CRYSTALS, GRAUPEL, AND HAIL
Edward E. Hindman, II and David B. Johnson Jul. 1972 51 p
(AD-746451; ENVPREDRSCHFAC-TP-4-72) Avail: NTIS CSCL 04/2

An empirical approximation is presented for estimating the growth of ice crystals by diffusion. The classical approach to the growth of ice crystals by accretion is expanded and coupled with the empirical approach to diffusion growth. This coupling simulates the growth of ice crystals to rimed crystals, rimed crystals to graupel, and graupel to hail. Detailed numerical information for these simulations is presented. Author (GRA)

N73-11661# Weather Squadron (15th), APO New York 09406. Detachment 19.
TERMINAL FORECAST REFERENCE FILE, RAMEY AFB, PUERTO RICO Final Report
Jan. 1972 53 p
(AD-746026) Avail: NTIS CSCL 04/2

The reference file discusses factors affecting the weather at Ramey AFB, Puerto Rico. Included are location and topography, weather controls, climatic aids, and a special synoptic study. Author (GRA)

N73-11662# Weather Squadron (17th), Kelly AFB, Tex. Detachment 07.
TERMINAL FORECAST REFERENCE FILE, KELLY AFB, TEXAS Final Report
1 Mar. 1972 77 p
(AD-746028) Avail: NTIS CSCL 04/2

The reference file discusses factors affecting the weather at Kelly AFB, Texas. Included are location and topography, weather controls, climatic aids, and local forecast studies. Author (GRA)

N73-11663# Alaska Univ., College. Geophysical Inst.
PHENOMENOLOGY OF ARCTIC PARTICLE PRECIPITATION Final Report, 1 Mar. 1969 - 28 Feb. 1972
Syun-Ichi Akasofu May 1972 11 p refs
(Contract F19628-69-C-0182; AF Proj. 5710; AF Proj. 5631)
(AD-746283; AFCRL-72-0330) Avail: NTIS CSCL 04/1

The report describes briefly results of the projects which had been carried out in assisting the airborne operation of the AFCRL Flying Laboratory. The authors analyzed most of all-sky photographs and some ionograms taken during the flights and ground magnetic records from auroral zone stations for all the flight periods, and have confirmed the existence of a circum-polar oval band of auroras, the auroral oval and the associated ionospheric structure during both quiet and disturbed periods (substorm periods). Author (GRA)

N73-11664# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A COMPARATIVE STUDY OF LASER METHODS OF AIR POLLUTION MAPPING
R. M. Measures Dec. 1972 45 p refs Sponsored by Dept. of Energy, Mines and Resources
(AD-746280; UTIAS-174) Avail: NTIS CSCL 13/2

A comparative study has been made of three laser methods of remotely mapping gaseous pollutants of the atmosphere. It has been found that, in the case of NO2 and SO2, Differential Absorption and Scattering has superior performance potential with regard to range and sensitivity than either Laser-Induced Fluorescence or Raman Backscattering. However, because of the sophistication of this system and the difficulty of interpretation, it is strongly recommended that from the long term point of view the fluorescence approach be pursued further as it has a range and sensitivity far superior to Raman backscattering for a given laser power. An analysis of the fluorescence return expected from a local source of NO2 indicates that a plume of about 10 ppm could be detected at a range of several kilometers. However, due to absorption effects, care must be used in the interpretation of signals emanating from local concentrations in excess of about 10 ppm. Author (GRA)

N73-11665# Texas A&M Univ., College Station. Dept. of Oceanography and Meteorology.
SIMULATION RESEARCH TO DEVELOP OBJECTIVE METEOROLOGICAL PREDICTION CAPABILITY Semiannual Report, 16 Nov. 1971 - 16 May 1972
Tom E. Sanford May 1972 105 p
(Contract DAAB07-68-C-0280; DA Proj. 1T0-6211-A-126)
(AD-746247; A/M-Ref-72-52; ECOM-0280-8; SAR-8) Avail: NTIS CSCL 04/2

The report is a continuation of the work included in AD-744793 regarding the investigation of the suitability of alternate expressions for the exchange coefficients for momentum, heat, and water vapor which are an integral part of the set of meteorological equations presently being used to simulate the atmospheric boundary layer. Solutions for Cases 6-A, 6-B, 7-A, 7-B and 8 of the Dallas Tower Network data, incorporating alternate exchange coefficients, are included in the report. These

solutions indicate that the alternate expressions for the exchange coefficients for momentum produces more realistic results which are consistent with the expected diurnal variation of the exchange coefficient and which yield predicted winds that are nearer to the observed values for the cases cited than those winds predicted by the original exchange coefficient relationships.

Author (GRA)

N73-11666# Aerospace Corp., El Segundo, Calif.
ON THE CORRELATION OF THE TOTAL PRECIPITABLE WATER IN A VERTICAL COLUMN AND ABSOLUTE HUMIDITY AT THE SURFACE Technical Report, Jul. 1971 - Jan. 1972
Earl E. Reber and James R. Swope 15 Apr. 1972 24 p refs
(Contract F04701-71-C-0172)
(AD-745954; TR-0172(2230-20)-13; SAMSO-TR-72-163) Avail: NTIS CSCL 04/2

The relationship between the total precipitable water in the atmosphere, and surface absolute humidity has been examined for more than 1500 upper-level soundings. Total precipitable water and surface absolute humidity were computed for all of the upper-level soundings made in 1970 at San Nicolas Island, Point Mugu, and China Lake, California. The stations, separated by less than 200 mi, are representative of a maritime, a coastal, and a desert environment, respectively. The monthly correlation coefficients, ranging from -0.25 to -0.89, indicate that a direct but widely variable relationship exists between the total precipitable water and surface absolute humidity; however, these results also demonstrate that estimates of total precipitable water from surface humidity measurements are not valid.

Author (GRA)

N73-11667# Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences.
THE VARIABILITIES OF WIND AND TEMPERATURE STRUCTURES IN THE LOWER TROPOSPHERE AS REVEALED BY AN INFRA-SONIC WAVE PROBE Interim Report
Andrew Chieu-an Chung 8 Jun. 1972 156 p refs
(Contract DA-31-124-ARO(D)-431; DA Proj. 2M0-61102-B-53-B)
(AD-745912; AROD-6086-4-EN) Avail: NTIS CSCL 04/2

Wind variations in the atmospheric boundary layer are studied by means of an acoustic propagation experiment. The source was a quarter wave resonant tube operating at about 13.5 cps. The receiver was located 9.2 km to the South East. From the periodicity of the fluctuations, and the magnitude of the amplitude and phase variations one can infer the magnitude and scale of the atmospheric turbulence. Author (GRA)

N73-11668# Oregon State Univ., Corvallis. Dept. of Oceanography.
THE 1970 TOTEM WIND AND CURRENT DATA
Noel B. Plutchak May 1972 72 p refs
(Contract N00014-68-A-0148; NR Proj. 083-230)
(AD-746832; Data-52; Ref-72-13) Avail: NTIS CSCL 04/2

First-order analyses of wind and current time series obtained from a Totem buoy off the Oregon coast during 1970 are presented. In addition, winds at Totem are compared with winds recorded simultaneously at Newport, Oregon. Author (GRA)

N73-11669# Environmental Prediction Research Facility (Navy), Monterey, Calif.
GEOGRAPHIC AND MONTHLY VARIATION OF RAPID INTENSIFICATION AND LOW LATITUDE WEAKENING OF TROPICAL CYCLONES OF THE WESTERN NORTH PACIFIC OCEAN
Samson Brand May 1972 30 p refs
(AD-746130; ENVPREDRSCHFAC-TP-5-72) Avail: NTIS CSCL 04/2

Twenty-five years of tropical storm and typhoon data for the western North Pacific (1945-1969) were evaluated to determine the geographic and seasonal variation of those tropical cyclones which rapidly intensified over the open ocean (plus or minus 50 knots increase in 24 hours) and those tropical cyclones that weakened at low latitudes over the open ocean (plus or minus 20 knots decrease in 24 hours, south of 25 N). The results show distinct geographic and seasonal preferences for both rapid intensification and low-latitude weakening of tropical cyclones. Author (GRA)

N73-11670# Environmental Prediction Research Facility (Navy), Monterey, Calif.
CHANGES IN THE CHARACTERISTICS OF TYPHOONS CROSSING THE PHILIPPINES
Samson Brand and Jack W. Blelloch May 1972 33 p refs
(AD-746131; ENVPREDRSCHFAC-TP-6-72) Avail: NTIS CSCL 04/2

Thirty typhoons (1960-1970) are examined to determine the effect of the Philippines on the intensity, speed of movement and size characteristics of tropical cyclones crossing the Philippines. The results show an average intensity (maximum surface wind), decrease of 33%, a northward perturbation as the storms pass through the Islands, and a decrease of circulation size for weak typhoons. The study also showed an increase in speed of movement as storms approach the Philippines.

Author (GRA)

N73-11671# Naval Scientific and Technical Intelligence Center, Washington, D.C. Translation Div.
MAN AND THE ELEMENTS
A. N. Mikhailov, A. V. Goreleichenko, and G. I. Kogan-Beletskii 30 Jun. 1972 19 p Transl. into ENGLISH from the book "Chelovek i Stikhiya" Leningrad, 1970 p 81-83, 128-129, 144-145
(AD-746738; NAVSTIC-Trans-3317) Avail: NTIS CSCL 04/2

Contents: Automatic meteorological stations; Planets and meteorology; The importance of rocket investigations of the atmosphere; The TU-144 and the weather. GRA

N73-11672# Environmental Prediction Research Facility (Navy), Monterey, Calif.
SPEED OF TROPICAL STORMS AND TYPHOONS AFTER RECURVATURE IN THE WESTERN NORTH PACIFIC OCEAN
Lawrence D. Burroughs and Samson Brand Jul. 1972 39 p refs
(AD-746880; ENVPREDRSCHFAC-TP-7-72) Avail: NTIS CSCL 04/2

Twenty-five years of tropical cyclone data (1945-1969) for the western North Pacific were evaluated to determine the speed of movement characteristics of tropical storms and typhoons following recurvature. The results show that the acceleration of storms following recurvature is a function of the time of year, the meteorological characteristics of the storm, and the surrounding synoptic environment. Forecast equations derived by linear regression techniques are presented for the speed of movement of tropical cyclones 36 hours after recurvature.

Author (GRA)

N73-11673# Freie Univ., Berlin (West Germany). Ins. fuer Meteorologie und Geophysik.
DAILY AND MONTHLY NORTHERN HEMISPHERE 5-MILLIBAR-SYNOPTIC WEATHER MAPS OF THE YEAR 1968, JANUARY - MARCH Quarterly Technical Status Report, Jan. - Mar. 1968
Barbara Kriester, Karin Labitzke, Karin Petzoldt, and Karl Sieland 1971 119 p refs
(Contract DAJA37-71-C-0993; DA Proj. 2M0-61102-B-53-B)
(AD-746659; QTSR-2) Avail: NTIS CSCL 04/2

The present volume contains a series of stratospheric weather maps for the 5-mb-level. Included are daily height and temperature analyses for three months for the northern hemisphere based on radiosonde and rocketsonde measurements and performed by using a hydrostatic buildup method. The corresponding monthly mean maps and their variations are included as well as the mean grid point data calculated from the daily values. The circulation pattern during the period under consideration is described with special emphasis on the processes at high latitudes. Author (GRA)

N73-11674# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
WARM FOG DISPERSAL BY AIRBORNE WIDE AREA HYGROSCOPIC PARTICLE SEEDING
Alan I. Weinstein and Bernard A. Silverman 1972 6 p refs
Repr. from the publ. "Preprint Volume of the Conference on

Weather Modification (3rd)" AMS, 1972 Conf. held at Rapid City, S. D., 26-29 Jun. 1972
(AF Proj. 7605)
(AD-746807; AFCRL-72-0426) Avail: NTIS CSCL 04/2

A two dimensional, time dependent warm fog model has been used to determine the effectiveness and cost of wide area urea seeding for warm fog dispersal at airports. The technique was found to need sufficient particle size control to require the use of microencapsulated seeding material. It was also found that the effectiveness of the technique was strongly related to the number concentration of the fog droplets. GRA

N73-11675# Naval Coastal Systems Lab., Panama City, Fla.
UNIVERSAL HUMIDITY CHART Formal Report
P. G. Sexton Jun. 1972 23 p refs
(AD-746162; NCSL-122-72) Avail: NTIS CSCL 04/2

Humidity charts suitable for use with gas mixtures of various compositions and for various pressures are rare in the literature. Present charts specifically for use with gas mixtures used in saturation diving require the use of separate charts and interpolation for pressures which are intermediate to those specifically presented. The Universal Humidity Chart in the report is a single chart allowing humidity and energy calculations for any mixture of monatomic and diatomic gases at pressures from 1 atmosphere to any pressure that might conceivably be encountered in saturation diving. The simplification is made possible by a judicious choice of units for humidity.
Author (GRA)

N73-11676# SysteMed Corp., Dayton, Ohio.
PROCEEDINGS OF THE 2ND ANNUAL CONFERENCE ON ENVIRONMENTAL TOXICOLOGY
Wright-Patterson AFB, Ohio AMRL Dec. 1971 319 p refs Conf. held at Fairborn, Ohio, 31 Aug. and 1-2 Sep. 1971
(Contract F33615-70-C-1046; AF Proj. 63)
(AD-746660; AMRL-TR-71-120) Avail: NTIS CSCL 06/20

Major technical areas discussed included toxicological evaluation of volatile halogenated compounds, protection of the public against air pollution and toxicological problems with aircraft, missiles, and space vehicles. Author (GRA)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N73-11677*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
CLOSED-FORM SOLUTIONS FOR ATOMSPHERIC FLIGHT WITH APPLICATIONS TO SHUTTLE GUIDANCE
Hugo L. Ingram 25 Sep. 1972 76 p refs
(NASA-TM-X-64694) Avail: NTIS HC $6.00 CSCL 22C

Closed-form solutions for the motion of a rocket-powered vehicle during atmospheric ascent and closed-form solutions for unpowered atmospheric reentry are developed. These closed-form solutions are then used to develop a simplified guidance scheme and to develop a variation-of-parameters integration of more accurate equations of motion with the closed-form solutions as base solutions. The variation-of-parameters integration of the more accurate equations of motion also allows the transition partial derivative matrices associated with these equations to be easily developed. Then the partial derivative transition matrices are used to develop a guidance scheme based on the more accurate equations of motion instead of the less accurate closed-form solutions. Author

N73-11678*# National Aeronautics and Space Administration, Washington, D.C.
LOCALIZATION ERRORS DUE TO THE IONOSPHERE, THE ALTITUDE OF THE BALLOONS, AND THE INACCURACY OF THE EPHEMERIDES
Sep. 1972 42 p Transl. into ENGLISH of CNES Mem. No. 8/65, CNES-368 Toulouse, Mar. 1966
(NASA-TT-F-14701; CNES-368) Avail: NTIS HC $4.25 CSCL 17G

The errors of localization due to the ionospheric effect are examined along with errors due to the variation of the altitude of the balloons. The errors due to inaccuracies in the ephemerides are also examined. Graphs of localization errors for various influences are included. F.O.S.

N73-11679*# Techtran Corp., Glen Burnie, Md.
ANTICOLLISION SYSTEM FOR SHIPS
Roger Gouillou Washington NASA Sep. 1972 16 p refs Transl. into ENGLISH from ONERA report TP-1093 Presented at Assoc. Maritime et Aeron. 1972 Session, 1972
(Contract NASw-2037)
(NASA-TT-F-14718; ONERA-TP-1093) Avail: NTIS HC $3.00 CSCL 17G

The use of time-frequency techniques to improve the information at the disposal of navigators and reduce the risk of collision of ships is examined. A system is described which permits the distance, the speed and ship's heading of every ship to be obtained directly. It consists of surveying the bearing with the help of static antennas of small volume. The procedures used to measure the distance under conditions of a poor signal/noise ratio and for that of the bearing are described. Author

N73-11680*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PASSIVE DUAL SPIN MISALIGNMENT COMPENSATORS Patent Application
James H. Donohue and Benjamin G. Zimmerman, inventors (to NASA) Filed 29 Sep. 1972 11 p
(NASA-Case-GSC-11479-1; US-Patent-Appl-SN-293739) Avail: NTIS HC $3.00 CSCL 22B

A combination dual-spined gyroscopically stabilized device is reported having a spinning rotor and a non-spinning platform. Two substantially lossless mechanical resonators, resonant at the spin frequency, are orthogonally disposed on the platform for compensation of the disturbing torque acting on the platform due to rotor misalignment. NASA

N73-11681# National Bureau of Standards, Washington, D.C.
SIMULATION OF AIR TRAFFIC CONTROL RADAR BEACON CODE ASSIGNMENT PLAN 3d1 Final Report
R. D. Elbourn and P. B. Saunders Sep. 1972 101 p ref
(Contract DOT-FA72WAI-257)
(FAA-RD-72-103) Avail: NTIS HC $7.25

During implementation of the National Airspace System En Route Stage A, some Air Route Traffic Control Centers will have complete radar data processing capability while other centers have only flight plan data processing capability. A digital computer simulation of three versions of a radar beacon code assignment plan designed for this situation is described. The simulation employs one peak day's IFR traffic in the U.S.A. It determines the number of codes required, the numbers of code changes in flight for various reasons, and the variation of the number of code conflicts with the number of codes used. Author

N73-11682*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SPACE SHUTTLE ORBITER GUIDANCE, NAVIGATION AND CONTROL SOFTWARE FUNCTIONAL REQUIREMENTS: HORIZONTAL FLIGHT OPERATIONS
24 Mar. 1972 22 p refs
(NASA-TM-X-68857; MSC-06747) Avail: NTIS HC $3.25 CSCL 17G

The shuttle GN&C software functions for horizontal flight operations are defined. Software functional requirements are grouped into two categories: first horizontal flight requirements and full mission horizontal flight requirements. The document privides the intial step in the shuttle GN&C software design process. It also serves as a management tool to identify analyses which are required to define requirements. Author

N73-11683# Federal Aviation Administration, Washington, D.C. Economic Analysis Div.
AN EVALUATION OF THE ARTS 3 LEVEL OF AUTOMATION (THIRD LOT PROCUREMENT) Final Report
Seymour M. Horowitz Jul. 1972 158 p refs
Avail: NTIS hc $10.00

An experiment employing air traffic controllers in a realistic,

but simulated, terminal environment was conducted to evaluate an automated air traffic control system. A simple terminal geometry was devised as the appropriate setting in which to compare the automated system with the manual system. In isolated experiments, the air controllers were presented with identical traffic samples under statistically controlled conditions. Measurements of the comparative system performance in seven major categories were taken. Statistical analyses of the evaluations are presented. Author

N73-11684# Federal Aviation Administration, Washington, D.C.
ENGINEERING AND DEVELOPMENT PROGRAM PLAN: EN ROUTE AUTOMATION Interim Report
Jun. 1972 155 p
(FAA-ED-12-2) Avail: NTIS HC $9.75

The functions of an automated system for processing flight data and surveillance functions are described. The need to improve the system capability to meet forecast demands is discussed. The program development plan to provide the required improvements is presented. The program goals, approach, development activities, expected results, and resource requirements are analyzed. Author

N73-11685# Naval Research Lab., Washington, D.C.
SAL STORAGE FOR THE AN/UPA-59/60 IFF (IDENTIFICATION FRIEND OR FOE) DECODERS
G. P. Nelson May 1972 35 p
(AD-746445; NRL-MR-2435) Avail: NTIS CSCL 17/7

The AN/UPA-59/60 IFF decoders can provide display of aircraft targets within an altitude layer selected by front panel switches. This operation is called Selected Altitude Layers (SAL) and can be of two different types. One type is called SAL parity, and is supposed to correlate a target's response to a Mode C interrogation against its response to another Mode of interrogation. For a variety of reasons, the SAL parity feature in the existing AN/UPA-59/60 decoders does not perform in an acceptable manner when it is installed in typical IFF systems. A modification of the existing decoders is proposed, consisting of a one-for-one replacement of a printed-circuit board within the main equipment. This replacement board makes use of a new intergrated circuit, called the rubber shift register, which was developed under an NRL contract and represents the first known use of this component. Author (GRA)

N73-11686# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
LANE IDENTIFICATION IN OMEGA
J. A. Pierce Jul. 1972 54 p refs
(Contracts N00014-67-A-0298-0008; N00014-67-A-0298-0006; N00014-67-A-0298-0005; NR Proj. 371-013)
(AD-746503; TR-627) Avail: NTIS CSCL 17/7

Difficulties in the prediction of the time of transmission of the difference frequency, in the Omega aid to navigation, can be relieved through a treatment based upon the theory of composite signals. It is shown that predictions for one of the carrier frequencies can be converted into predictions for the other carrier frequency, or the difference frequency, or any of a number of composite signals. A simple nomogram is presented that makes it easy to convert Sky Wave Compensation numbers published by the U.S. Navy for any of these purposes. Author (GRA)

N73-11687# Electronic Communications, Inc., St. Petersburg, Fla.
FEASIBILITY STUDY OF BANDWIDTH REDUCTION TECHNIQUE FOR LORETS SYSTEM
E. J. Dalabakis and G. R. Shoubridge Nov. 1971 43 p
(Contract F33657-71-C-0121)
(AD-746055; SER-71-1243; ESD-TR-72-272) Avail: NTIS CSCL 17/7

The purpose of this feasibility study and test demonstration was to conduct analysis for a bandwidth reduction technique to be incorporated in a LORAN Retransmission (LORETS) System. The design concept resulting from the analysis was then breadboarded and tested in the laboratory to prove out the feasibility of using a bandwidth reduction technique with a LORETS System. The analysis that led to the original design concept is presented in this report. The breadboard bandwidth reduction system is also presented with results of this system with simulated LORAN signals, with the system hard wired at the down converted spectrum, and with the system over a hard wired RF link using LORAN C signals. Author (GRA)

N73-11688# Naval Postgraduate School, Monterey, Calif.
KALMAN FILTERING TECHNIQUES APPLIED TO AIRBORNE DIRECTION-FINDING AND EMITTER LOCATION M.S. Thesis
L. Laddie Coburn Jun. 1972 96 p refs
(AD-745888) Avail: NTIS CSCL 17/3

The objective of this analytical study was to develop an optimal emitter location algorithm using Kalman filtering techniques to filter emitter bearing angles-of-arrival information in an airborne, multi-emitter environment. Since emitter and aircraft navigation data were sampled at discrete time intervals, discrete sequential estimation techniques were used within a software computer program which initially sorted data, filtered emitter bearing angles-of-arrival to obtain optimal estimates, and computed emitter positions in latitude/longitude coordinates using various emitter location algorithms. An error analysis was performed on the emitter location algorithms to determine relative accuracy of the different techniques. Extended Kalman filtering was also considered as an alternate approach to the emitter location algorithm. Author (GRA)

N73-11689# Army Missile Command, Redstone Arsenal, Ala. Guidance and Control Directorate.
SUBOPTIMAL ESTIMATION OF INERTIAL SYSTEM ERROR STATES USING RADAR AREA CORRELATION AND ALTIMETER POSITION MEASUREMENTS
Harold L. Pastrick 6 Jun. 1972 171 p refs
(DA Proj. 1X2-63306-D-073)
(AD-745897; RG-TR-72-14) Avail: NTIS CSCL 17/7

The report describes one of several alternatives being explored to establish advanced guidance techniques for the Army's long range tactical missile, the PERSHING. The analysis is given for estimating the inertial measurement unit's error states in an aided terminal guidance mode. Position observations measured by a radar area correlation system and a radar altimeter are processed in an extended Kalman filter to yield the suboptimal estimates of the inertial measurement unit's errors. The dynamics of the inertial system are modeled in four coordinate systems to allow the choice of the least complex mechanization. To minimize on-board computer requirements, an analysis of the filter's performance is made by comparing the optimal filter gains with a filter formulated with fixed gains chosen a posteriori from those computed optimally. GRA

N73-11690# Aeronautical Chart and Information Center, St. Louis, Mo. Technical Translation Section.
FIRST FIELD TEST OF THE ELECTRONIC DISTANCE MEASURING INSTRUMENT LUCH
M. I. Vernitskii Jun. 1972 15 p Transl. into ENGLISH from Geodeziya i Kartografiya (USSR), no. 9, 1970 p 8-13
(AD-746017; ACIC-TC-1843) Avail: NTIS CSCL 17/7

The geodetic distance measuring instrument Luch was first used operationally to establish geodetic ties in nets separated by 40 - 60 km of water. Such a transmission of coordinates by the method of triangulation or trilateration using other distance-measuring instruments would entail many serious technical difficulties and expenses. The use of the range finder Luch made it possible to essentially simplify this problem. Random errors with the Luch are small. Author (GRA)

N73-11691# Naval Postgraduate School, Monterey, Calif. Dept. of Electrical Engineering.
IMPLEMENTATION AND TESTING OF A PROPOSED DIFFENTIAL OMEGA SYSTEM M.S. Thesis
Robert Lawrence Vence, Jr. Jun. 1972 148 p refs
(AD-745878) Avail: NTIS CSCL 17/7

Omega is a very low frequency VLF navigation system which will give world-wide coverage with eight stations when fully implemented. Using published skywave correction tables accuracies of 1 to 2 n.mi. are attainable. Through the use of differential Omega, correction information can be disseminated to users in the vicinity of a monitor site. Differential Omega

accuracies are directly proportional to distance from the monitor site and are 0.26 - 0.5 n.mi. at 200 n.mi. from the monitor site. A system using U.S. Coast Guard radiobeacons as the differential information transmitter was proposed by Goodman and McKaughan. Their proposals were examined and improvements suggested. Two additional differential Omega systems being proposed by civilian contractors were also examined.
Author GRA

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N73-11692 National Lending Library for Science and Technology, Boston Spa (England).
DRAG COEFFICIENTS FOR FUEL ELEMENT SPACER GRIDS
K. Rehme 10 Jul. 1972 9 p Transl. into ENGLISH from Atomkernenergie (West Germany), v. 15, no. 2, 1972 p 127-130
(NLL-Risley-TR-2440-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A modified pressure drop coefficient is used to present measured pressure drop results on grid spacers for rod bundles in a hexagonal arrangement and in a hexagonal flow channel.
Author

N73-11693 National Lending Library for Science and Technology, Boston Spa (England).
CORROSION BEHAVIOUR OF THE INTERSTITIAL ALLOYING ELEMENTS OF SODIUM-COOLED FAST BREEDER REACTOR CANNING MATERIALS IN SODIUM
E. D. Grosser 10 Jul. 1972 7 p Transl. into ENGLISH from German Atom Forum Reactor Meeting p 339-342
(NLL-Risley-TR-2444-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The behavior of interstitial alloying elements in the potential sodium cooled fast breeder canning materials 1.4988 (niobium-stabilized steel) and 1.4970 (boron containing steel) is considered. It is shown that the boron-alloyed steel is subject to greater interstitial corrosion and that both materials suffer a temperature dependent partial loss of nitrogen.
G.G.

N73-11694*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 1: BASE NUCLEAR SYSTEM SAFETY Final Report
Jan. 1972 44 p refs
(Contract NAS8-26283)
(NASA-CR-123842; DOC-72SD4201-1-1) Avail: NTIS HC $4.25 CSCL 18F

The mission and terrestrial nuclear safety aspects of future long duration manned space missions in low earth orbit are discussed. Nuclear hazards of a typical low earth orbit Space Base mission (from natural sources and on-board nuclear hardware) have been identified and evaluated. Some of the principal nuclear safety design and procedural considerations involved in launch, orbital, and end of mission operations are presented. Areas of investigation include radiation interactions with the crew, subsystems, facilities, experiments, film, interfacing vehicles, nuclear hardware and the terrestrial populace. Results of the analysis indicate: (1) the natural space environment can be the dominant radiation source in a low earth orbit where reactors are effectively shielded, (2) with implementation of safety guidelines the reactor can present a low risk to the crew, support personnel, the terrestrial populace, flight hardware and the mission, (3) ten year missions are feasible without exceeding integrated radiation limits assigned to flight hardware, and (4) crew stay-times up to one year are feasible without storm shelter provisions.
Author

N73-11695*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 2: SPACE BASE PRELIMINARY NUCLEAR SAFETY ANALYSIS. PART 1: NUCLEAR SAFETY ANALYSIS Final Report
Jan. 1972 521 p refs
(Contract NAS8-26283)
(NASA-CR-123838; Doc-72SD4201-2-1-Vol-2-Pt-1) Avail: NTIS HC $28.25 CSCL 18F
For Abstract see N73-11694

N73-11696*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 3: REACTOR SYSTEM PRELIMINARY NUCLEAR SAFETY ANALYSIS. PART 1: REFERENCE DESIGN DOCUMENT (RDD) Final Report
Jan. 1972 99 p refs
(Contract NAS8-26283)
(NASA-CR-123844; Doc-72SD4201-3-1-Vol-3-Pt-1) Avail: NTIS HC $7.00 CSCL 18F

The Reference Design Document, of the Preliminary Safety Analysis Report (PSAR) - Reactor System provides the basic design and operations data used in the nuclear safety analysis of the Rector Power Module as applied to a Space Base program. A description of the power module systems, facilities, launch vehicle and mission operations, as defined in NASA Phase A Space Base studies is included. Each of two Zirconium Hydride Reactor Brayton power modules provides 50 kWe for the nominal 50 man Space Base. The INT-21 is the prime launch vehicle. Resupply to the 500 km orbit over the ten year mission is provided by the Space Shuttle. At the end of the power module lifetime (nominally five years), a reactor disposal system is deployed for boost into a 990 km high altitude (long decay time) earth orbit.
Author

N73-11697*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 3: REACTOR SYSTEM PRELIMINARY NUCLEAR SAFETY ANALYSIS. PART 2: ACCIDENT MODEL DOCUMENT (AMD) Final Report
Jan. 1972 309 p refs
(Contract NAS8-26283)
(NASA-CR-123839; Doc-72SD4201-3-2-Vol-3-Pt-2) Avail: NTIS HC $17.50 CSCL 18F

The Accident Model Document is one of three documents of the Preliminary Safety Analysis Report (PSAR) - Reactor System as applied to a Space Base Program. Potential terrestrial nuclear hazards involving the zirconium hydride reactor-Brayton power module are identified for all phases of the Space Base program. The accidents/events that give rise to the hazards are defined and abort sequence trees are developed to determine the sequence of events leading to the hazard and the associated probabilities of occurence. Source terms are calculated to determine the magnitude of the hazards. The above data is used in the mission accident analysis to determine the most probable and significant accidents/events in each mission phase. The only significant hazards during the prelaunch and launch ascent phases of the mission are those which arise form criticality accidents. Fission product inventories during this time period were found to be very low due to very limited low power acceptance testing.
Author

N73-11698*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 3: REACTOR SYSTEM PRELIMINARY NUCLEAR SAFETY ANALYSIS. PART 2A: ACCIDENT MODEL DOCUMENT, APPENDIX Final Report
Jan. 1972 276 p refs
(Contract NAS8-26283)
(NASA-CR-123845; Doc-72SD4201-3-2A-Vol-3-Pt-2A) Avail: NTIS HC $16.00 CSCL 18F

The detailed abort sequence trees for the reference zirconium hydride (ZrH) reactor power module that have been generated for each phase of the reference Space Base program mission are presented. The trees are graphical representations of causal sequences. Each tree begins with the phase identification and the dichotomy between success and failure. The success branch

shows the mission phase objective as being achieved. The failure branch is subdivided, as conditions require, into various primary initiating abort conditions. Author

N73-11699*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 3: REACTOR SYSTEM PRELIMINARY NUCLEAR SAFETY ANALYSIS. PART 3: NUCLEAR SAFETY ANALYSIS DOCUMENT (NSAD) Final Report
Jan. 1972 142 p refs
(Contract NAS8-26283)
(NASA-CR-123846; Doc-72SD4201-3-3-Vol-3-Pt-3) Avail: NTIS HC $9.25 CSCL 18F

Nuclear safety analysis as applied to a space base mission is presented. The nuclear safety analysis document summarizes the mission and the credible accidents/events which may lead to nuclear hazards to the general public. The radiological effects and associated consequences of the hazards are discussed in detail. The probability of occurrence is combined with the potential number of individuals exposed to or above guideline values to provide a measure of accident and total mission risk. The overall mission risk has been determined to be low with the potential exposure to or above 25 rem limited to less than 4 individuals per every 1000 missions performed. No radiological risk to the general public occurs during the prelaunch phase at KSC. The most significant risks occur from prolonged exposure to reactor debris following land impact generally associated with the disposal phase of the mission where fission product inventories can be high. Author

N73-11700*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 4: SPACE SHUTTLE NUCLEAR SYSTEM TRANSPORTATION. PART 1: SPACE SHUTTLE NUCLEAR SAFETY Final Report
Jan. 1972 196 p refs
(Contract NAS8-26283)
(NASA-CR-123847; Doc-72SD4201-4-1-Vol-4-Pt-1) Avail: NTIS HC $12.00 CSCL 18F

An analysis of the nuclear safety aspects (design and operational considerations) in the transport of nuclear payloads to and from earth orbit by the space shuttle is presented. Three representative nuclear payloads used in the study were: (1) the zirconium hydride reactor Brayton power module, (2) the large isotope Brayton power system and (3) small isotopic heat sources which can be a part of an upper stage or part of a logistics module. Reference data on the space shuttle and nuclear payloads are presented in an appendix. Safety oriented design and operational requirements were identified to integrate the nuclear payloads in the shuttle mission. Contingency situations were discussed and operations and design features were recommended to minimize the nuclear hazards. The study indicates the safety, design and operational advantages in the use of a nuclear payload transfer module. The transfer module can provide many of the safety related support functions (blast and fragmentation protection, environmental control, payload ejection) minimizing the direct impact on the shuttle. Author

N73-11701*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 5: NUCLEAR SYSTEM SAFETY GUIDELINES. PART 1: SPACE BASE NUCLEAR SAFETY Final Report
Jan. 1972 217 p refs
(Contract NAS8-26283)
(NASA-CR-123848; Doc-72SD4201-5-1-Vol-5-Pt-1) Avail: NTIS HC $13.00 CSCL 18F

The design and operations guidelines and requirements developed in the study of space base nuclear system safety are presented. Guidelines and requirements are presented for the space base subsystems, nuclear hardware (reactor, isotope sources, dynamic generator equipment), experiments, interfacing vehicles, ground support systems, range safety and facilities. Cross indices and references are provided which relate guidelines to each other, and to substantiating data in other volumes. The guidelines are intended for the implementation of nuclear safety related design and operational considerations in future space programs. Author

N73-11702*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 5: NUCLEAR SYSTEM SAFETY GUIDELINES. PART 2: SPACE SHUTTLE/NUCLEAR PAYLOADS SAFETY Final Report
Jan. 1972 140 p refs
(Contract NAS8-26283)
(NASA-CR-123843; Doc-72SD4201-5-2-Vol-5-Pt-2) Avail: NTIS HC $9.00 CSCL 21F

The design and operations guidelines and requirements developed in the study of space shuttle nuclear system transportation are presented. Guidelines and requirements are presented for the shuttle, nuclear payloads (reactor, isotope-Brayton and small isotope sources), ground support systems and facilities. Cross indices and references are provided which relate guidelines to each other, and to substantiating data in other volumes. The guidelines are intended for the implementation of nuclear safety related design and operational considerations in future space programs. Author

N73-11703*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 6: SPACE BASE NUCLEAR SYSTEM SAFETY PLAN Final Report
Jan. 1972 72 p refs
(Contract NAS8-26283)
(DOC-72SD4201-6-Vol-6) Avail: NTIS HC $5.75 CSCL 18F

A qualitative identification of the steps required to assure the incorporation of radiological system safety principles and objectives into all phases of a manned space base program are presented. Specific areas of emphasis include: (1) radiological program management, (2) nuclear system safety plan implementation, (3) impact on program, and (4) summary of the key operation and design guidelines and requirements. The plan clearly indicates the necessity of considering and implementing radiological system safety recommendations as early as possible in the development cycle to assure maximum safety and minimize the impact on design and mission plans. Author

N73-11704*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MANNED SPACE FLIGHT NUCLEAR SYSTEM SAFETY. VOLUME 7: LITERATURE REVIEW. PART 1: LITERATURE SEARCH AND EVALUATION Final Report
Jan. 1972 78 p refs
(Contract NAS8-26283)
(NASA-CR-123850; DOC-72SD4201-7-1-Vol-7-Pt-1) Avail: NTIS HC $6.00 CSCL 18F

A review of the literature used in conducting the manned space flight nuclear system safety study is presented. The objectives of the presentation are to identify and evaluate for potential application to study the existing related literature and to provide the information required to include the related literature in the NASA Aerospace Safety Research and Data Institute. More than 15,000 documents were evaluated and identification forms were prepared for 850 reports. Author

N73-11705*# IIT Research Inst., Chicago, Ill.
ADVANCED MISSION APPLICATIONS OF NUCLEAR ELECTRIC PROPULSION
Daniel J. Spadoni Jul. 1972 52 p refs
(Contract NASw-2144)
(NASA-CR-129134; T-31) Avail: NTIS HC $4.75 CSCL 21F

Current analysis of advanced unmanned planetary missions in the 1980's and beyond indicate the need for propulsion systems with performance capabilities beyond those of current and near state-of-art. One propulsion system concept being considered to fill this need is nuclear electric low thrust propulsion (NEP). Two different NEP system power levels are considered for performance analysis: 100 kw and 250 kw. The 100 kw NEP system uses a Centaur(D-1T) chemical stage for injection to an interplanetary transfer and the 250 kw system uses a spiral escape maneuver. Performance comparison is in general made

on the basis of net payload at the target as a function of flight time. NEP performance is shown for unconstrained and constrained (20,000 hours) thrusting time. Specific impulse is optimized and ranges from 4000 sec to 7000 sec. Author

N73-11706# Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
FILLING ALLOYS FOR FAST BREEDER FUEL ELEMENT CONDITIONING
P. R. Heylen, J. G. Wurm (EURATOM), and A. Avogadro (EURATOM) Luxembourg EURATOM 1972 39 p refs Sponsored by EURATOM
(EUR-4857e) Avail: NTIS HC $4.00; Commission of the Euopean Communities, D.G. XIII - C.I.D., 29, rue Aldringen, Luxembourg B.Fr. 50

A filling alloy concept for the conditioning of fast breeder fuel elements has been studied. The filling alloy is cast into the fuel element right at the reactor discharge, so that fuel pins are surrounded by a solid leak tight metal matrice, which improves the mechanical properties of the fuel element and prevents the fission gases to escape. The following three filling alloys have been investigated: Al-Mn (10 wt.%) MPt 700 C, Cu-Mg (9.7 wt. %)MPt 722 C and Al-V (2 wt. %)MPt 735 C. Laboratory results have shown that stainless steel corrosion rates are very low provided the casting temperature does not exceed 800 C. Also Na could be dissolved to some extent. It is shown that with the filling alloy concept most of the unit operations along the Head-end flow-sheet will be less complicated and expensive. Author

N73-11707*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
NEUTRON RADIATION CHARACTERISTICS OF PLUTONIUM DIOXIDE FUEL
Mojtaba Taherzadeh 1 Dec. 1972 23 p refs Revised (Contract NAS7-100)
(NASA-CR-129098; JPL-TR-32-1555-Rev-1) Avail: NTIS HC $3.25 CSCL 18H

The major sources of neutrons from plutonium dioxide nuclear fuel are considered in detail. These sources include spontaneous fission of several of the Pu isotopes, reactions with low Z impurities in the fuel, and reactions with O-18. For spontaneous fission neutrons a value of (1.95 plus or minus 0.07) X 1,000 n/s/q PuO2 is obtained. The neutron yield from (alpha, neutron) reactions with oxygen is calculated by integrating the reaction rate equation over all alpha particle energies and all center-of-mass angles. The results indicate a neutron emission rate of (1.42 plus or minus 0.32) X 10,000 n/s/q PuO2. The neutron yield from (alpha, neutron) reactions with low Z impurities in the fuel is presented in tabular form for one part per million of each impurity. The total neutron flux emitted from a particular fuel geometry is estimated by adding the neutron yield due to the induced fission to the other neutron sources. Author

N73-11708*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUCLEAR POWER PLANTS FOR MOBILE APPLICATIONS
John L. Anderson 1972 34 p refs Presented at 8th Propulsion Joint Specialists Conf., New Orleans, 29 Nov. - 1 Dec. 1972; sponsored by Am. Inst. of Aeron. and Astronaut. and the Soc. of Automotive Engr.
(NASA-TM-X-68154; E-7191) Avail: NTIS HC $3.75 CSCL 18E

Mobile nuclear powerplants for applications other than large ships and submarines will require compact, lightweight reactors with especially stringent impact-safety design. The technical and economic feasibility that the broadening role of civilian nuclear power, in general, (land-based nuclear electric generating plants and nuclear ships) can extend to lightweight, safe mobile nuclear powerplants are examined. The paper discusses technical experience, identifies potential sources of technology for advanced concepts, cites the results of economic studies of mobile nuclear powerplants, and surveys future technical capabilities needed by examining the current use and projected needs for vehicles, machines, and habitats that could effectively use mobile nuclear reactor powerplants. Author

N73-11709# Nuclear-Chicago Corp., Austin, Tex. Nuclear Div.
DEVELOPMENT AND CONSTRUCTION OF AN INSTRUMENT TO DETECT FISSIONABLE MATERIALS Technical Report, 1 May 1969 - 15 Dec. 1971
Ben S. Burton and M. N. Anastasi Kirtland AFB, N. Mex. AFWL May 1972 72 p refs
(Contract F29601-69-C-0089; AF Proj. 1752)
(AD-747051; AFWL-TR-71-145) Avail: NTIS CSCL 18/4

A radiac set (AN/PDR-69) for surveying areas contaminated with fissionable materials has been developed for use in the field under adverse environmental conditions. Eight prototypes have been constructed; several of these have been subjected to environmental testing at Air Force Weapons Laboratory with generally satisfactory results. A scintillation probe, with pulse-height analysis, serves for selective detection of L X radiation or low-energy gamma radiation emitted by the contaminants or their daughters. A digital display indicates the counting rate in the pulse-height window. Design and development studies are discussed. Physical and operational characteristics of the instrument are described. Author (GRA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology; and 29 Space Radiation.

N73-11710# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
THE MODULATION TRANSFER FUNCTION IN ROOM ACOUSTICS AS A PREDICTOR OF SPEECH INTELLIGIBILITY
T. Houtgast and H. J. M. Steeneken 1972 23 p refs
(IZF-1972-13; TDCK-59868) Avail: NTIS HC $3.25

The relevance of the modulation transfer function (MTF) was investigated for quantifying speech intelligibility in enclosures. For a great number of transmission paths, set up in the laboratory (reverberation and single echos, combined with several degrees of noise interference), the MTF for modulation frequencies from 0.25 to 25 Hz and the intelligibility score from listening tests (PB-word score) were determined. It appeared that, for each condition, a single value could be deduced from the MTF which correlates highly with the PB-word score. The data suggest that the MTF may serve as a convenient predictor of intelligibility in room acoustics, with an accuracy of about 4% in PB-word score. Author

N73-11711# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
PLACE DEPENDENCE OF TIMBRE IN REVERBERANT SOUND FIELDS
R. Plomp and H. J. M. Steeneken 1972 30 p refs
(IZF-1972-15; TDCK-59944) Avail: NTIS HC $3.50

The sound pressure level of a simple tone in a diffuse sound field was studied and experiments are reported indicating that the timbre dissimilarity at any two positions is rather well correlated with the difference in frequency spectrum. The effect of the randomness of phase was found to be negligible for complex tones with fundamental frequencies above 100 Hz. The analysis of recordings of steady state organ tones in a large concert hall gives results which are in agreement with the theory. It is shown that the variance of frequency spectra measured in db squared per one-third octave band is a good measure of the extent to which the characteristic timbres of complex tones are blurred by reverberation. Author

N73-11712*# Techtran Corp., Glen Burnie, Md.
PRINCIPLES OF THE INFORMATION THEORY OF VISIBILITY IN THE ATMOSPHERE: CHAPTER TITLES AND INTRODUCTION
V. K. Kagan and K. Ya. Kondratev Washington NASA Jun. 1972 13 p Transl. into ENGLISH from "Osnovy Informatsionnoy Teorii Vidimosti v Atmosfere" Leningrad, Gidrometeoizdat., 1968 (Contract NAS5-14826)
(NASA-TT-F-14435) Avail: NTIS HC $3.00 CSCL 20F

The index and introduction to Principles of the Information Theory of Visibility in the Atmosphere are presented. F.O.S.

N73-11713*# Translation Consultants, Ltd., Arlington, Va.
CONDITIONS OF COHERENCE IN DIFFRACTION SPECTRA PRODUCED IN LIQUIDS ON ULTRANSONIC STANDING WAVES
R. Baer Washington NASA Nov. 1972 12 p refs Transl. into ENGLISH from Helv. Phys. Acta (Basel), v. 8, no. 7, 1935 p 591-600
(Contract NASw-2038)
(NASA-TT-F-13925) Avail: NTIS HC $3.00 CSCL 20N

Experiments, conducted to determine which of the different diffraction spectra produced on ultrasonic standing waves in liquids through the diffraction of light are coherent, i.e., can be brought to interfere with each other are described. The result indicates that any arbitrary pairing of two spectra with even ordinal numbers (including zero order) possesses at least one common component of coherent light; the same is true for any pairing from the group of spectra with odd ordinal numbers. On the other hand, any spectrum of the first group is completely incoherent in combination with any spectrum of the second group. The patterns of ultrasonic standing waves produced by the superposition of several or all of the diffraction spectra, may also be explained by such coherence properties. Experimentally determined coherence properties are exactly those obtained from the assumption that higher diffraction spectra originate in multiple diffraction (Brillouin theory). Author

N73-11714*# Translation Consultants, Ltd., Arlington, Va.
CERTAIN EXPERIMENTS TO DEMONSTRATE THE DIFFRACTION OF LIGHT BY ULTRASONIC WAVES
R. Baer Washington NASA Nov. 1972 12 p refs Transl. into ENGLISH from Helv. Phys. Acta (Basel), v. 6, no. 8, 1933 p 570-580
(Contract NASw-2038)
(NASA-TT-F-13926) Avail: NTIS HC $3.00 CSCL 20N

Photographs of diffraction spectra originating in the diffraction of light by ultrasonic waves are reproduced. They show that the intensity at which individual diffraction spectra occur is a function of the ordinal number, which exhibits maxima and minima. The positions of the maxima and minima depends on the intensity of the sound beam, the value of the sound wavelength/light wavelength and on the length of the path of the light beam within the sound wave. The experimental arrangement described records fields of ultrasonic waves in liquids, the diffraction of waves by a wire screen and the refraction and reflection of an ultrasonic beam at the interface of two liquids are examined.
Author

N73-11715*# Techtran Corp., Glen Burnie, Md.
LOUDNESS OF UNIFORM NOISES
E. Zwicker and R. Feldtkeller Washington NASA Nov. 1972 21 p refs Transl. into ENGLISH from Acustica (Stuttgart), v. 5, 1955 p 303-316
(Contract NASw-2037)
(NASA-TT-F-13912) Avail: NTIS HC $3.25 CSCL 20A

With the aid of equal loudness contours, of the measured width of the frequency groups and reduction of loudness in neighboring frequency groups, the level of sustained noises with given spectra can be calculated. The aural analysis of a sound into bands of definite size already demonstrated for the hearing threshold, masking and phase detection, appears meaningful in the investigation of noise levels. Loudness is estimated from the sound intensity in the frequency groups, acting separately at low intensities but with considerable throttling of one group by neighboring ones at high intensities. Author

N73-11716# Defence Research Information Centre, Orpington (England).
DISCHARGE IN GAS AT HIGH PRESSURE INITIATED BY A BEAM OF FAST ELECTRONS
B. M. Kovalchuk et al Aug. 1971 16 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. Tekh. Fiz. (Moscow), v. 6, 1971 p 21-29
(DRIC-Trans-2857; BR-30234) Avail: NTIS HC $3.00

Discharge in nitrogen at pressures up to 16 atm. initiated by a beam of electrons with an average energy of 100 to 350 keV was investigated. A channel-free form of discharge was obtained with voltages above 100,000 V and switching currents of some tens of kA. The channel-free form of discharge is characterized by absorption in the gas of specific power of the order of 10 to 1000 MW/cu cm or more in a time interval of the order of 100 microseconds. Author (ESRO)

N73-11717# Magnetic Corp. of America, Cambridge, Mass.
LIGHTWEIGHT SUPERCONDUCTING MHD MAGNETS. VOLUME 2: 10 MW LEVEL MAGNET SYSTEM DESIGN AND PROJECTIONS FOR FUTURE DEVELOPMENT Final Report, May 1970 - Mar. 1972
Richard J. Thome and John J. Stekly Wright-Patterson AFB, Ohio AFAPL Jun. 1972 70 p
(Contract F33615-70-C-1567; AF Proj. 3145)
(AD-745322 ; AFCRL-TR-72-32-Vol-2) Avail: NTIS CSCL 09/1

This is the final report for the development of a superconducting magnet system for magnetohydrodynamic power generation. The information is presented in two volumes. Volume II describes the parametric optimization and design of a 10 megawatt level MHD superconducting magnet system and projections for future development. Author (GRA)

N73-11718# Pennsylvania State Univ., University Park. Dept. of Physics.
SCATTERING AND SPECTROSCOPY Final Report, 1 Jul. 1971 - 30 Jun. 1972
D. H. Rank 30 Jun. 1972 12 p refs
(Contract N00014-67-A-0385-0012)
(AD-746497) Avail: NTIS CSCL 20/1

A brief summary of work in the general areas of spontaneous scattering, stimulated scattering and molecular spectra is given. In spontaneous scattering measurement of sound speeds in SF6 were made. The effect upon the sound speed of frequency and density was studied. Shear waves in liquids and the Krishnan effect in plastics was another researched. Four topics in stimulated scattering are summarized. Finally the research summary lists work in IR spectroscopy. GRA

N73-11719# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
ARTILLERY SOUND RANGING COMPUTER SIMULATIONS
Robert P. Lee May 1972 61 p refs
(DA Proj. 1T0-61102-B-53-A)
(AD-745887; ECOM-5441) Avail: NTIS CSCL 17/1

The report demonstrates that aliasing can occur between microphone placement errors and wind and temperature estimation errors. A new type of field test is described to measure statistically the effect of wind and temperature fields on atmospheric sound ranging. From the contour error curves presented it can be seen that when a geometric solution is employed there can be an increase as great as 25% in the area enclosed by a given error contour if three microphones are used instead of six. With the development of a practical least-squares computer for field use, six microphones would result in an even greater increase in useable coverage. Author (GRA)

N73-11720# SACLANT ASW Research Center, La Spezia (Italy).
DIGITAL ANALYSIS WORKING GROUP
Robert Laval and Alessandro Barbagelata 1 May 1972 106 p refs Proc. of Conf. held at SACLANCEN, 25-27 May 1971
(AD-746204; SACLANTCEN-Conf-Proc-6) Avail: NTIS CSCL 17/1

The report contains proceedings of a conference held at SACLANTCEN on May 25-27, 1971. Session one consisted of reports on digital acquisition of acoustic signals and session two consisted of reports on digital analysis of acoustic and oceanographic data. GRA

N73-11721# Naval Research Lab., Washington, D.C.
INFRASONIC FAR-FIELD RADIATION FROM A TURBULENT WAKE Interim Report
John A. Desanto 29 Jun. 1972 7 p refs
(RF05552402)
(AD-747238; NRL-7421) Avail: NTIS CSCL 20/1

The acoustic far-field pressure and intensity due to a turbulent wake is calculated using Lighthill's free-turbulence theory. The radiation intensity is plotted as a function of the Mach number and of the ratio of wake wavelength to radiating wavelength.
Author (GRA)

N73-11722# Harvard School of Public Health, Boston, Mass.
APPLICATIONS OF TEXTURE PERCEPTION IN THE ANALYSIS OF COMPLEX OPTICAL IMAGERY Final Report, Jan. 1968 - Jul. 1971
Ronald M. Pickett Wright-Patterson AFB, Ohio AMRL 11 May 1972 93 p refs
(Contract F33615-68-C-1147; AF Proj. 7183)
(AD-746658; AMRL-TR-71-81) Avail: NTIS CSCL 20/6

These studies examine the feasibility of using texture perceptions in scientific or technical analyses of complex optical imagery. Section 1 illustrates that reliable quantitative data can be derived from texture perceptions, provided appropriate psychometric techniques are employed. Section 2 illustrates, in the context of medical imagery screening, a procedure which may often be required to translate the idiosyncratic visual assessments of expert observers into standardized psychometric procedures, some of which might then be carried out by untrained observers. Section 3 reports studies of reliability and validity when observers follow psychometric procedures in measuring the over-all appearance of Pap smears. The report suggests that applications of texture perception could be made in a wide range of situations requiring scientific or technical analyses of complex imagery, particularly where automated assessment is not available or prohibitively expensive. A thesaurus of descriptors of complex optical imagery with 1707 entries is attached.
Author (GRA)

N73-11723# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STUDY OF THE ELECTRICAL STRENGTH OF LONG AIR GAPS
V. P. Larionov 2 May 1972 17 p refs Transl. into ENGLISH from papers from Inter-Institute Conf. on Dielec. and Semiconduct Breakdown (Moscow)/Leningrad) 1964 p 54-58
(AD-746853; FTD-MT-24-1622-71) Avail: NTIS CSCL 20/3

The author reports on long-wave air-gap strength studies. Fresh information is given on the laws governing the development of discharge processes for internal overvoltages associated with switch-off transients. Detailed analyses of the discharge-time components and of gap field nonuniformity are presented. Basic features of the volt-second characteristics of the rod-plane gap obtained with 10--8-/2000-microsecond waves are discussed.
Author (GRA)

N73-11724# Ohio State Univ., Columbus. ElectroScience Lab.
INVESTIGATION OF 10.6 MICRON PROPAGATION PHENOMENA Quarterly Technical Report, 8 Jan. - 8 Apr. 1972
R. S. Davidson, II Griffiss AFB, N. Y. RADC Jun. 1972 23 p refs
(Contract F30602-70-C-0003; ARPA Order 1279)
(AD-747052; ESL-2880-7; RADC-TR-72-158) Avail: NTIS CSCL 20/6

The delivery and field testing of the Dual Channel Infrared Scanner System are reported along with details concerning the computer interface being constructed for the ElectroScience Laboratory data reduction facility. A description of the transmitting optics being supplied to RADC is also included in the report. Recent attempts at applying analytic continuation to a band limited image to improve image resolution are discussed.
Author (GRA)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N73-11725*# San Francisco Univ., Calif. Dept. of Physics.
ON CHARGED PARTICLE TRACKS IN CELLULOSE NITRATE AND LEXAN Interim Technical Report
E. V. Benton and R. P. Henke Jul. 1972 39 p refs
(Contract NAS8-26758)
(NASA-CR-123918; ITR-19) Avail: NTIS HC $4.00 CSCL 20H

Investigations were performed aimed at developing plastic nuclear track detectors into quantitative tools for recording and measuring multicharged, heavy particles. Accurate tract etch rate measurements as a function of LET were performed for cellulose nitrate and Lexan plastic detectors. This was done using a variety of incident charged particle types and energies. The effect of aging of latent tracks in Lexan in different gaseous atmospheres was investigated. Range distributions of high energy N-14 particle bevatron beams in nuclear emulsion were measured. Investigation of charge resolution and Bragg peak measurements were carried out using plastic nuclear track detectors.
Author

N73-11726# Atomic Energy of Canada Ltd., Chalk River (Ontario). Physics Div.
[NUCLEAR, SOLID STATE, AND THEORETICAL PHYSICS RESEARCH] Progress Report, 1 Apr. - 30 Jun. 1972
Aug. 1972 92 p refs
(AECL-4257; PR-P-94; Rept-2161-72) Avail: NTIS HC $6.75; Scientific Document Distribution Office, Atomic Energy of Canada Ltd., Chalk River, Ontario $2.00

Research activities provided: (1) alpha decay properties for certain levels in N-20 and a theoretical model of that nucleus; (2) a method for determining U-235/U-238 ratios in uranium ores; (3) resonance neutron spectra in Tl-203; (4) measurements of neutron scattering from liquid helium; (5) theoretical model of lattice vibration in molecular crystals; (6) relationship between specific heat and temperature in $NaNO_3$; (7) crystal vibration measurements in Pb-Sn-Te alloys; (8) vacancy formation energy measurements in Al; (9) production of high purity germanium crystals and germanium detectors; (10) hydrodynamic model for fluid oscillations in tube; (11) calculations on gas bubble growth in zirconium alloys; and (12) various computer programs for nuclear research applications.
G.G.

N73-11727# Hahn-Meitner-Institut fuer Kernforschung, Berlin (West Germany).
FOUR PARTICLE CORRELATIONS IN NUCLEI
Joerg Eichler Sep. 1972 63 p refs Presented at 5th Summer School in Nucl. Phys., Rudziska, Poland, 1972
(HMI-B125; BP-20) Avail: NTIS HC $5.25

Indications of nuclear alpha structure are observed in Li ions and still heavier projectiles accelerated to energies high enough to overcome the Coulomb barrier. Then, a direct transfer of alpha particles becomes feasible. The extreme selectivity of these reactions rests on the strongly excited levels that are interpreted theoretically as being predominantly 4-particle 4-hole states. Theoretical attempts to describe four body correlations center on: (1) Four body structures which only have the quantum number $S = T = 0$ in common with the alpha particle; and (2) four body structures which are correlated like alpha particles not only in angular momentum and isospin space but also in coordinate space. For lighter nuclei, the geometrical structures into which spatially correlated alpha particles may arrange themselves are studied by relaxing the requirements to $J = T = 0$ instead of $S = T = 0$. Such a coupling scheme is meaningful in a j-representation and leads to the notion of quartets and quadruplets.
G.G.

N73-11728# Hamburg Univ. (West Germany).
INELASTIC ELECTRON-PROTON SCATTERING IN THE REGION OF DELTA (1236) RESONANCE Ph.D. Thesis [INELASTISCHE ELEKTRON - PROTON - STREUUNG IM GEBIET DER DELTA (1236) - RESONANZ]
Wolf-Rainer Dix 2 Feb. 1972 81 p refs In GERMAN
Avail: NTIS HC $6.25

Measurements of absolute effective cross sections for inelastic electron-proton scattering at electron scattering angle of 86 deg and for impulse transfers between 0.40 and 0.78 (GeV/c) squared are reported for the first nuclear resonance region. A combination of obtained data with effective cross section results from below 13.33 deg angles is used to separate the longitudinal from the transversal part in the doubly differential cross section for electron production at Delta(1236) resonance. The transversal cross section exhibits pronounced resonance behavior with a maximum at $W = 1.22$ GeV, whereas the longitudinal cross section does not disclose any resonance.
Transl. by G.G.

N73-11729# Technische Universitaet, Brunswick (West Germany). Naturwissenschaftlichen Fakultaet.
MEASUREMENT OF THE ELASTIC DIFFERENTIAL SCATTERING CROSS SECTIONS Ph.D. Thesis [MESSUNG ELASTISCHER DIFFENTIELLER STREUQUERSCHNITTE]
Horst Hose 15 Jul. 1971 127 p refs In GERMAN
Avail: NTIS HC $8.50

The differential scattering cross sections of potassium on argon, nitrogen, carbon dioxide, methane, ethane, difluordichlormethane, methylfluoride and tetrafluormethane were determined by crossed molecular beam method. Measured was the angular distribution of scattered potassium particles in the plane between both beams which is equivalent to the differential scattering cross section. The quotient was determined by the angle-dependent intensities of scattered potassium particles and the intensity of the overall scattered cross section in the high vacuum system. Transl. by G.G.

N73-11730*# Pittsburgh Univ., Pa. Dept. of Physics.
EXCITATION OF ATOMIC NITROGEN BY ELECTRON IMPACT
E. J. Stone and E. C. Zipf Oct. 1972 34 p refs
(Grant NGL-39-011-002; Contract DA-31-124-ARO(D)-440; ARPA order 826)
(NASA-CR-129087) Avail: NTIS HC $3.75 CSCL 20H

Absolute cross sections were measured for the excitation of the N I(1134, 1164, 1168, 1200, 1243, and 1743 A) multiplets by electron impact on atomic nitrogen. The presence of vibrationally excited molecular nitrogen in the discharged gas was confirmed, and its effect on the measurements is discussed. The ratio of the oscillator strengths of the 1200 and 1134 A resonance transitions is presented, as well as the branching ratio for the N I(1311/1164 A) multiplets. Striking differences in the distribution of intensity between the spectra of atomic nitrogen and molecular nitrogen excited by energetic electrons suggest an optical method for measuring the density of atomic nitrogen in the upper atmosphere. Author

N73-11731*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
CALCULATION OF QUASI-STATIC HELIUM TRIPLET DIFFUSE LINE PROFILES
Carl D. Scott Washington Sep. 1972 152 p refs
(NASA-TN-D-6954; MSC-S-312) Avail: NTIS HC $3.00 CSCL 20H

Calculated spectral line profiles (intensity distributions) of the helium triplet diffuse series were obtained using the quasi-static approximation for ions and electrons. In these calculations, Doppler broadening, although negligible in most of the cases, was included as a device to avoid singularities. Plots and tabulations of the calculated profiles are presented, in addition to a discussion of the computational procedure and the validity of the calculations. Author

N73-11732# National Bureau of Standards, Washington, D.C. Inst. for Basic Standards.
BIBLIOGRAPHY ON ATOMIC LINE SHAPES AND SHIFTS, 1889 THROUGH MARCH 1972
J. R. Fuhr, W. L. Wiese, and L. J. Roszman Sep. 1972 166 p refs Sponsored in part by ARPA
(NBS-SP-366; LC-72-600147) Avail: SOD $1.75 as C 13.10:366

The bibliography covers exhaustively the atomic spectral line broadening literature in about 1400 separate references. The bibliography contains four major parts: (1) general interest papers are cataloged according to the broadening mechanisms and as to whether the work is a general theory, a general review, a table of profiles or parameters, a comment on existing work, a study of general experimental measurement techniques, or an experimental effort of general importance. (2) Papers containing numerical data are ordered as to element, ionization stage, broadening mechanism (in the case of foreign gas broadening the perturbing species are listed), and it is indicated whether the data are experimentally or theoretically derived. (3) References are listed completely by journal, authors, and title and are arranged chronologically and alphabetically within each year according to the principal author. (4) Authors and their papers are listed. Author

N73-11733*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio. Nuclear Medicine Lab.
A TARGET DESIGN FOR IRRADIATION OF NaI AT HIGH BEAM CURRENT
J. W. Blue and V. J. Sodd 1972 11 p refs Presented at Ann. Meeting of the Soc. of Nucl. Med., Atlanta, 1-4 Nov. 1972 Prepared in cooperation with Cincinnati Gen. Hosp., Ohio Sponsored in part by HEW
(NASA-TM-X-68156) Avail: NTIS HC $3.00 CSCL 20H

A solution to the targetry problems encountered when the iodine nucleus is a target for cyclotron irradiation is given as a target design. A target based on this design was used in 30 microampere irradiations of 46 MeV alpha particles for one-half hour without significant damage. Such an irradiation produces 6 to 7 mCi of Cs-129. This target should also be considered for cyclotron production of the radioisotopes Cs-127, I-123, and Xe-127. Author

N73-11734# Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
STUDY OF METASTABLE ATOM SHOCK DEACTIVATION IN THE SHOCK TUBE [UNTERSUCHUNG DER STOSSDESAKTIVIERUNG METASTABILER ATOME IM STOSSWELLENROHR]
F. Naumann Apr. 1972 122 p refs In GERMAN
(MPI-PAE/Extraterr-65) Avail: NTIS HC $8.25

A method was developed for the measurement of effective cross sections for the deactivation of metastable atomic states by shocks between neutral atoms at thermal shock energies. The measurement principle is the generation of a momentaneous deviation from the thermodynamic equilibrium in the electronic excitation of atoms by fast increase of the gas kinetic temperature in a plane shock wave with a high carrier gas surplus. The time constant for readjustment of the thermodynamic equilibrium is obtained from a special form of absorption spectroscopy, from which the average effective cross section can be deduced. An application is described with the metastable levels of barium and thallium, in presence of argon, neon, and a mixture of argon and 1 percent nitrogen. Author (ESRO)

N73-11735# Stanford Research Inst., Menlo Park, Calif.
TIME-OF-FLIGHT MEASUREMENT OF N2 PLUS MEINEL LIFETIMES Final Report, 15 Aug. 1971 - 30 Jun. 1972
James R. Peterson and John T. Moseley 28 Jul. 1972 26 p refs
(Contract N00014-71-C-0366; ARPA Order 1859; SRI Proj. P/U-1364; NR Proj. 012-141)
(AD-746157) Avail: NTIS CSCL 07/4

Radiative lifetimes of N2 (+) (A doublet Pi (u)) have been determined for vibrational levels v' = 18. A time-of-flight method was used to overcome collisional and diffusion effects that have affected most other measurements. Author (GRA)

N73-11736# Florida State Univ., Tallahassee. Dept. of Physics.
EXPERIMENTS WITH ENERGETIC HEAVY IONS Final Report, 1 Mar. 1971 - 29 Feb. 1972
Robert H. Davis and Norman P. Heydenburg May 1972 89 p refs
(Grant AF-AFOSR-2096-71; AF Proj. 9767)
(AD-746330; AFOSR-72-1319TR) Avail: NTIS CSCL 20/8

The report discusses the research on heavy ion physics. Reaction mechanisms studies, searches for new unstable residual nuclei, and transfer reaction experiments have been undertaken to characterize the collisions of heavy ions in terms of bombarding energy, structure of the collision partners, and processes leading to new and unusual isotopes. There is some evidence that fission-like processes occur even in relatively light, but highly-excited nuclear systems. The results of heavy ion experiments test models for compound nuclei at high excitation and reactions mechanisms yielding products far from the valley of stability. Progress is reported on the construction of a quadrupole spectrometer which will be used for heavy ion research and on the feasibility of a very heavy, very highly-ionized positive-ion source. The investigation includes precise Q-value and threshold measurements, isobaric analogue state studies, and nucleon transfer studies for light projectiles. Author (GRA)

N73-11737# Mount Auburn Research Associates, Inc., Newton Upper Falls, Mass.
STUDY OF ACOUSTIC GRAVITY WAVE GENERATION BY NUCLEAR DETONATIONS Final Report, 16 Feb. 1971 - 15 Feb. 1972
S. L. Kahalas, T. I. McLaren, and Brian L. Murphy 15 Apr. 1972 83 p refs
(Contract F44620-71-C-0086; ARPA Order 1502)
(AD-746328; AFOSR-72-1331TR) Avail: NTIS CSCL 18/3

Conclusions based on previous work done on the contract and published in detail elsewhere are first reviewed. The earlier work treated the generation and propagation of both long period (3-10 minutes) and short period (1-60 seconds) acoustic signals from nuclear detonations. Also included in the review are conclusions reached concerning Rayleigh wave generation by atmospheric explosions. Recent work, reported for the first time, is then described. This consists of: (a) An analysis of the relationship of different kinds of disturbance seen in the ionosphere to the hydrodynamic motions accompanying a low altitude nuclear explosion. Both the detonation blast wave and the buoyant rising fireball are considered as sources of ionospheric disturbance. (b) A laboratory investigation of the internal gravity waves generated by buoyant rise in a density stratified medium.
Author (GRA)

N73-11738# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
A CODE FOR AIRCRAFT SURVIVABILITY, ANALYSIS: GAMMA AND NEUTRON EFFECTS M.S. Thesis
Robert Douglas McLaren Jun. 1972 154 p refs
(AD-746015; GNE/PH/72-8) Avail: NTIS CSCL 18/3

The report presents a code, developed by the author, that predicts neutron and gamma fluences, including neutron induced gammas, in an exponential atmosphere for burst altitudes between 7 and 100 kilometers. The problem was solved by using the diffusion equation, with separation of virgin and scattered particles, in a nonorthogonal coordinate system. The diffusion equation in this coordinate system was approximated by a nine point difference equation and the resulting matrix equation was solved by use of a block tri-diagonal algorithm. The resulting computer code, in FORTRAN Extended, was written to calculate the survivability of up to 100 aircraft or space vehicles in addition to the calculation of fluences.
Author (GRA)

N73-11739# Naval Postgraduate School, Monterey, Calif. Dept. of Physics.
CALCULATION OF ELECTRON ENERGY LOSSES IN VARIOUS METALS M.S. Thesis
Joe Christopher Midgett Jun. 1972 54 p refs
(AD-747077) Avail: NTIS CSCL 20/8

A reformulation of the Blunck and Westphal theory of electron energy loss in metals was performed for the metals beryllium, aluminum, copper, tin, gadolinium, and lead. Comparison with previous theoretical calculations shows good agreement for the most probable energy loss and for the full widths at half maximum of the electron energy loss distributions. The computer program designed for these calculations is given. It is an improvement over previous programs in both computation time and simplicity. A semi-empirical formula for the most probable energy loss was calculated. This formula agrees, within a few percent, with the most probable energy loss calculated according to the Blunck and Westphal theory except in the case of thick (3 gm/sq cm) absorbers of heavy elements. The full width at half maximum for the energy loss distribution is presented in graphical form as functions of target thickness and atomic number.
Author (GRA)

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N73-11740 National Lending Library for Science and Technology, Boston Spa (England).
INITIAL FORMATION OF BEAMS OF HYDROGEN IONS
V. V. Vecheslavov and V. A. Gorbunov [1972] 13 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 14, no. 7, Jul. 1969 p 1264-1268
(NLL-DRIC-Trans-2351-(3623.66)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Calculated and experimental data are given for systems involving initial formation of a beam of hydrogen ions for the specific case of an incompressible beam with a current of 24 mA and with an extraction voltage of 40 kV. An account is given of the Pearce optical system, of the defocusing action of the extractor hole, and of the free dispersion of the beam behind the extractor. The calculated and experimental curves of the ion beam are compared.
Author

N73-11741*# Iowa Univ., Iowa City. Dept. of Physics and Astronomy.
STRONGLY MAGNETIZED CLASSICAL PLASMA MODELS
David Montgomery 1972 157 p refs Submitted for publication
(Grant NGL-16-001-043)
(NASA-CR-129177; U-of-Iowa-72-17) Avail: NTIS HC $10.00 CSCL 20I

The class of plasma processes for which the so-called Vlasov approximation is inadequate is investigated. Results from the equilibrium statistical mechanics of two-dimensional plasmas are derived. These results are independent of the presence of an external dc magnetic field. The nonequilibrium statistical mechanics of the electrostatic guiding-center plasma, a two-dimensional plasma model, is discussed. This model is then generalized to three dimensions. The guiding-center model is relaxed to include finite Larmor radius effects for a two-dimensional plasma.
Author

N73-11742# Nagoya Univ. (Japan). Inst. of Plasma Physics.
AZBEL KANER RESONANCE IN GASEOUS PLASMAS
Kazuo Minami Jul. 1972 21 p refs
(IPPJ-134) Avail: NTIS HC $3.25

The cyclotron resonances of ordinary electromagnetic fields in dense gaseous plasmas are analyzed. The phenomenon is similar to Azbel Kaner resonance in cryogenic metals. The collisionless absorption of electromagnetic fields by electrons and the propagation of slow electromagnetic waves in a dense plasma are investigated in some detail. Numerical calculations of refractive indices of ordinary waves are shown for a wide range of plasma parameters.
Author

N73-11743# Nagoya Univ. (Japan). Inst. of Plasma Physics.
CHARACTERISTIC OSCILLATIONS OF A CYLINDRICAL PLASMA
Tadatsugu Hatori and Tsuguhiro Watanabe Aug. 1972 32 p refs
(IPPJ-133) Avail: NTIS HC $3.75 CSCL 20I

The characteristic oscillations of the plasma in a point cusp are studied. An idealized model for the real plasma in a point cusp is considered. Here the unperturbed state of the plasma is cylindrically symmetric and homogeneous along the uniform magnetic field (z direction). An RF field is applied externally in the direction of the x-axis by distant parallel plate electrodes. This configuration of electrodes is most efficient so far as the RF plugging effect is concerned. The radius of the plasma considered is assumed to be of the ion thermal Larmor radius. Electrons, whose effects have been completely neglected for the sheet plasma are treated in two ways, the drift approximation and the Boltzmann distribution.
Author

N73-11744# Nagoya Univ. (Japan). Inst. of Plasma Physics.
EQUATIONS FOR A PLASMA CONSISTING OF MATTER AND ANTIMATTER
A. H. Nelson and K. Ikuta Aug. 1972 45 p refs Supported in part by a Roy. Soc. Overseas Res. fellowship
(IPPJ-131) Avail: NTIS HC $4.25

A set of fluid-type equations was derived to describe the macroscopic behavior of a plasma consisting of a mixture of matter and antimatter. The equations are written in a form which displays the full symmetry of the medium with respect to particle charge and mass. The symmetry of the equations facilitates their manipulation and solution, and the equations are used to analyze the propagation of electromagnetic and acoustic waves through a matter-antimatter plasma. Some differences from the

propagation of such waves in a normal plasma are noted.
Author

N73-11745# Nagoya Univ. (Japan). Inst. of Plasma Physics.
NONLINEAR MODULATION OF ELECTROMAGNETIC WAVES IN A PLANE-BOUNDED PLASMA
James W. VanDam Aug. 1972 24 p refs
(IPPJ-136) Avail: NTIS HC $3.25

The extension to two dimensions of the reductive perturbation method is discussed and applied to the problem of electromagnetic waves propagating in a cold electron plasma bounded by two conducting planes. The behavior of the amplitude modulation was found to be governed by a nonlinear Schrodinger equation, from which the stability of the wave can be determined in some limiting cases. Author

N73-11746# Nagoya Univ. (Japan). Inst. of Plasma Physics.
INDUCTION OF dc CURRENT BY AN RF TRAVELLING WAVE IN A STRONG MAGNETIC FIELD
Yukio Midzuno Aug. 1972 22 p refs
(IPPJ-135) Avail: NTIS HC $3.25

On the basis of a simple model the dc current induced by an RF travelling wave is calculated. It is assumed that the initial velocity distribution of electrons is Maxwellian and that the electrons move adiabatically on a magnetic line of force. An evaluation of the required RF power for sustaining the plasma current in Golovin's model of the Tokamak fusion reactor is made. Author

N73-11747# Groupe de Recherches Ionospheriques, Issy-les-Moulineaux (France).
AUTOMATIC COMMAND AND CONTROL DEVICE FOR A PLASMA CHAMBER. TECHNICAL SPECIFICATIONS [ENSEMBLE AUTOMATIQUE DE COMMANDE ET CONTROLE POUR UN CAISSON A PLASMA CAHIER DES CONDITIONS ET SPECIFICATIONS TECHNIQUES]
L. R. O. Storey, J. M. Illiano, Y. Arnal, P. Gille, J. L. Michau, K. Phan, P. Ferrand, and R. Blanc 26 Jun. 1972 28 p In FRENCH
Prepared jointly with Soc. Telemecanique
(Contract CNET-77.45.041)
(GRI/NTP/102) Avail: NTIS HC $3.50

The detailed configuration of an automatic control system is described. It is based on a Telemecanique T 2000 computer and is intended for an ionospheric plasma simulation chamber. This chamber is to be used in future years for testing space oriented plasma probes. The actual design is flexible and can easily be modified or extended. It allows for a check of the instruments associated with the chamber and collection of scientific data. One of the main features of this design is the possibility of a real time dialogue, modification of measuring cycles, visual display, etc. All data are stored on the computer and can subsequently be processed. Author (ESRO)

N73-11748# European Space Research Inst., Frascati (Italy).
THEORETICAL FEATURES OF ANOMALOUS RESISTIVITY IN A TURBULENT PLASMA CONFINED IN A STRONG MAGNETIC FIELD
Marino Dobrowolny and Franco Santini (FOM-Inst. voor Plasmafysica) 1972 25 p refs Submitted for publication
Sponsored by Ned. Organ. voor Zuiver-Wetenschap. Onderzoek (ZWO) and EURATOM
Avail: NTIS HC $3.25

The problem of anomalous resistivity observed in plasmas confined in a strong magnetic field is discussed with regard to the low and high electric field regime. For low applied electric field and electron temperature greater than ion temperature, the effect of a turbulent spectrum of ion-sound waves is investigated. Quasi-linear effects as well as trapping of particles into the waves and correlations among the waves are taken into consideration. Due to these effects a higher resistivity enhancement is found than from conventional theories of ion-sound turbulence but still it is low with respect to that in the observations. Possible explanations are suggested. In the high electric field regime the presence is discussed of a second spectrum of electron plasma waves. The conditions are given for which a decay of the latter waves into ion waves can explain the observed behavior of the anomalous resistivity.
Author (ESRO)

N73-11749# Danish Meteorological Inst., Charlottenlund.
INTERPLANETARY MAGNETIC FIELD DIRECTION AND HIGH LATITUDE IONOSPHERIC CURRENTS
T. Stockflet Jorgensen, E. Friis-Christensen, and J. Wilhjelm 1972 10 p refs Submitted for publication
(DMI-Geophys-Papers-R-32) Avail: NTIS HC $3.00

The relationship between the interplanetary and high latitude and magnetic fields is discussed. It was assumed that the equatorial components of the interplanetary and magnetospheric field lines merge. Author (ESRO)

N73-11750# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
EXPERIMENTS ON THE APPLICATION OF LASER SELECTIVE EXCITATION SPECTROSCOPY TO THE DIAGNOSTICS OF A POTASSIUM PLASMA
A. B. Rodrigo Apr. 1972 131 p refs
(Grant AF-AFOSR-1608-68; AF Proj. 9752)
(AD-745964; UTIAS-180; AFOSR-72-1193TR) Avail: NTIS CSCL 20/9

A thermally tuned Q-switched ruby laser of moderate power, with emission wavelength at 6939A, has been used to selectively excite the 4 doublet P(3/2)-6 doublet S(1/2) transition in the atoms of a pure potassium plasma of low degree of ionization produced in a hot cathode diode. A pulse of intensified spontaneous emission has been produced at 6939A, 6911A and at a number of other wavelengths, as a result of the laser selective excitation. The characteristics of the plasma intensified emission pulse have been observed to depend on the local conditions of the plasma, at the point of intersection of the laser beam and the solid angle of observation, estimated by a Langmuir probe. The possibility of using this type of interaction for the purpose of diagnosing the plasma has been studied experimentally.
Author (GRA)

N73-11751# Stanford Univ., Calif. Dept. of Mechanical Engineering.
NONEQUILIBRIUM PHENOMENA IN FOLLOWING PLASMAS FOR MHD POWER GENERATION AND PROPULSION SYSTEMS Progress Report, 15 Feb. 1971 - 14 Feb. 1972
R. H. Eustis, C. H. Kruger, and M. Mitchner May 1972 7 p refs
(Contract F44620-68-C-0051; AF Proj. 9752)
(AD-746068; AFOSR-72-1295TR) Avail: NTIS CSCL 20/9

The report discusses progress on work pertaining to non-equilibrium phenomena in flowing plasmas. Measurements of vibration-translation and vibration-vibration relaxation rates in rapid expansions of mixtures of N2 and CO2 in argon have been made. The results generally exceed those measured in shock-heating and laser-fluorescence experiments, and indicate a deficiency in available theory. Experiments have been conducted to investigate the influence of channel size on the ionization instability, in order to provide a means of extending information on small scale devices to predictions for full sized power generators. It was found, for example, that the effective Hall parameter decreased with increasing channel size. A mathematical model has been formulated to predict the effect of N2 addition on the non-equilibrium properties of argon and alkali-metal-seed plasmas. Agreement between calculated and experimental values of electrical conductivity was quite satisfactory. Author (GRA)

N73-11752# Naval Research Lab., Washington, D.C.
LASER-INDUCED SOURCES FOR MAGNETIC FIELDS Interim Report
John A. Stamper 16 Jun. 1972 24 p
(NRL Proj. H02-27B)
(AD-746098; NRL-7411) Avail: NTIS CSCL 20/9

Large magnetic fields are produced near the target when a powerful laser pulse is focused onto a solid target. A discussion is given of how the laser radiation produces conditions in the laser-produced plasma which allow the conversion of thermal energy to magnetic field energy. This concept of a thermal source generating the magnetic field is illustrated by deriving the source function for a spherical plasma. It is shown that the necessary nonadiabatic conditions exist in the presence of laser radiation. At a sufficiently high intensity (approximately 10 to the 14th power W/square cm), the linear polarization of the radiation produces a corresponding anisotropy in the electron velocity distribution. Magnetic sources then exist for any spatial

variation of pressure and density. Sources due to the direct action of radiation pressure are also discussed. This implies that part of the laser radiation is absorbed by direct conversion (no heating) from laser field energy to magnetic field energy. An estimate is made of the magnetic field produced in the region where laser radiation is being absorbed. Such fields can be quite large--in the megagauss range. Author (GRA)

N73-11753# Cornell Univ., Ithaca, N.Y. Graduate School of Aerospace Engineering.
THEORY OF ION BOUNDARY LAYERS
Ronald A. Johnson and P. C. T. DeBoer Jan. 1972 9 p refs Revised
(Contract N00014-67-A-0077-0001; NR Proj. 061-019)
(AD-746094) Avail: NTIS CSCL 20/9

Theories are presented for the electric boundary layers that form on flat-plate and cylindrical probes aligned parallel with a high speed flow, when the probe potential is large and negative. Both slightly ionized continuum flows and collisionless plasmas are considered. In the former case, the probe potential is supposed sufficiently large to make the electric boundary layer thick compared with the viscous boundary layer. The corrections arising from the presence of the viscous boundary layer are calculated. The cases considered are solved either by an integral method, or by a quasi-one-dimensional method. The results obtained can be used to determine the freestream ion density from the current measured experimentally. A comparison is made between theory and some available experimental data. Author (GRA)

N73-11754# TRW Systems Group, Redondo Beach, Calif.
MAGNETIC FIELD ANNIHILATION OF IMPULSIVE CURRENT SHEETS Interim Scientific Progress Report
C. L. Dailey 31 May 1972 38 p refs
(Contract F44620-71-C-0031; AF Proj. 9752)
(AD-746044; TRW-18706-6001-TO-00; AFOSR-72-1307TR) Avail: NTIS CSCL 20/9

The report presents the results achieved to date from an experimental study of impulsive plasma acceleration in an inductive device. The geometry of the magnetic fields produced in this machine is such that plasma acceleration by means of a hydromagnetic wave, that converts field energy to kinetic energy, is expected to occur. The purpose of the experiment is to study this mechanism of plasma acceleration by magnetic field annihilation. The experimental data consist of measurements of the radial and axial magnetic field components as a function of time and location within the accelerator. A computer analysis of these data has been made and the results are presented as magnetic flux contour maps and contour maps of plasma current density which are calculated by the computer from the magnetic field data. The maps are also drawn by the computer. Author (GRA)

N73-11755# Aerospace Corp., El Segundo, Calif.
NEUTRON ENERGY AND FLUX DISTRIBUTIONS FROM A CROSSED-FIELD ACCELERATION MODEL OF PLASMA FOCUS AND Z-PINCH DISCHARGES Technical Report, Sep. 1969 - Sep. 1971
Melvin J. Bernstein and Gerald G. Comisar 30 May 1972 42 p refs
(Contract F04701-71-C-0172)
(AD-745955; TR-0172(2220-60)-3; SAMSO-TR-72-165) Avail: NTIS CSCL 18/1

Anisotropic distributions of neutron fluxes and neutron energy spectra are calculated for D-D reactions in self-pinching discharges, particularly for a plasma focus. A generalized beam-target model is assumed where (1) high-energy deuterons have angular distributions consistent with a crossed-field acceleration mechanism, and (2) these energetic deuterons undergo fusion collisions primarily with stationary target ions. Energy distributions of ions proportional to 1/(E sub d) cubed in the range from 50 to as high as 600 keV give computed results agreeing with many experimental observations at laboratory angles of 0, 90, and 180 deg. These ion-energy distributions can account for a 50- to 100-fold increase in neutron yeild when a deuterium-tritium gas mixture is used. Author (GRA)

N73-11756# Case Western Reserve Univ., Cleveland, Ohio.
STRUCTURE OF A COLLISIONLESS TURBULENT SHOCK WAVE IN PLASMAS
Mahmoud H. Ahmed Jun. 1972 156 p refs
(Contract N00014-67-A-0404-0007)
(AD-746467; TR-A-64) Avail: NTIS CSCL 20/9

A perpendicular collisionless shock wave in a high beta infinite plasma is considered. The effects of the inhomogeneity of the shock front have been analyzed. It was found that the ions are heated up and that the resonant particles see a larger component of the electric field in the direction of he inhomogeneity. From the linear stability it was found that the fastest growing unstable modes inside the shock front are the beam-cyclotron and pure cyclotron modes. The effects of high beta values on these instabilities have been investigated. A new theory has been developed to handle the non-linear evolution of unstable modes. Equations governing the structure of the shock front valid for low as well as high Mach numbers have been derived. Author (GRA)

N73-11757# Naval Research Lab., Washington, D.C.
LOW FREQUENCY PARAMETRIC INSTABILITIES OF MAGNETIZED PLASMAS WITH TWO ION SPECIES Interim Report
Edward Ott, John B. McBride, and Joseph H. Orens Jul. 1972 28 p refs
(AD-746109; NRL-MR-2460) Avail: NTIS CSCL 20/9

The authors present a theoretical and computer simulation treatment of the response of magnetized plasmas with two ion species to low frequency, electric fields oscillating at (Omega sub 0) near the lower hybrid frequency (Omega sub LH) that shows the existence of parametric instabilities. A decay instability involving the Buchsbaum two-ion resonance occurs for (Omega sub 0) = (Omega sub LH), and a purely growing instability occurs for (Omega sub 0) - (Omega sub LH). The analysis is valid even when the masses of the ion components are comparable and applies, for example, to deuterium-tritium plasmas. Computer simulation experiments demonstrate the potential importance of these instabilities as ion heating mechanisms. Author (GRA)

N73-11758# Ohio State Univ., Columbus. ElectroScience Lab.
DATA ANALYSIS PROGRAMS FOR REFLECTOMETER DIAGNOSIS OF THIN BOUNDARY LAYER PLASMA SHEATHS: USER'S MANUAL Technical Report, Apr. 1969 - Sep. 1971
Logan R. Zintsmaster Kirtland AFB, N. Mex. AFWL Mar. 1972 86 p refs
(Contract F29601-69-C-0086; AF Proj. 5791)
(AD-747041; AFWL-TR-70-90) Avail: NTIS CSCL 20/9

The user's manual describes the use and algorithms of the FORTRAN 4 programs written to analyze data from a thin boundary layer plasma experiment. The experiment consists of an onboard measurement at two or three frequencies of the aperture reflection coefficient of a flush mounted rectangular aperture using a five probe reflectometer. The five probe voltages are used to calculate a reflection coefficient which is transformed through an inhomogeneous dielectric filled waveguide to the aperture. The measured aperture reflection coefficient is compared to aperture reflection coefficients calculated for an exponential model plasma and stored in a table to obtain a minimum mean square error fit. Author (GRA)

N73-11759# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTROLLED THERMONUCLEAR SYNTHESIS
L. A. Artsimovich 20 Apr. 1972 19 p Transl. into ENGLISH from the Russian Report
(AD-747111; FTD-MT-24-2139-71) Avail: NTIS CSCL 20/9

The author discusses the current state of development of the two main closed magnetic systems used in obtaining a high-temperature plasma, the stellarator and the tokamak. Adiabatic magnetic traps are also briefly discussed, as well as the plasma focus. The paper is a very brief generalization of the current state of high-temperature plasma physics. Author (GRA)

N73-11760# Columbia Univ., New York. Dept. of Microbiology.
REFLECTOMETER DIAGNOSIS OF THIN BOUNDARY-LAYER PLASMA SHEATHS Technical Report, Apr. 1969 -

Dec. 1971
Logan R. Zintsmaster and J. W. Mayhan Kirtland AFB, N. Mex. AFWL Apr. 1972 90 p refs
(Contract F29601-69-C-0086; AF Proj. 5791)
(AD-747038; AFWL-TR-70-89) Avail: NTIS CSCL 20/9

A multiple-probe reflectometer technique is developed to diagnose the detailed structure of the boundary-layer plasma formed on high-performance reentry vehicles. This technique uses aperture reflection coefficients measured onboard at three discrete frequencies to determine an equivalent exponential electron density profile. Particular emphasis is placed on the turbulent boundary layer of a ballistic, hypersonic reentry vehicle at low altitudes. Aspects of the design are discussed and system parameters are recommended for implementation. Data analysis programs are described. Author (GRA)

26 PHYSICS, SOLID STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N73-11761 National Lending Library for Science and Technology, Boston Spa (England).
COMPENSATION IN SEMICONDUCTORS
E. E. Klotynsh Aug. 1972 23 p refs Transl. into ENGLISH from Poluprov. ikh Primen. v Elektrotekh. (USSR), v. 4, 1970 p 19-37
(NLL-RTS-7358) Avail: Natl. Lending Library, Boston Spa, Engl.: £2-30: 8 NLL photocopy coupons

In extrinsic semiconductors (GaAs, InP) compensating impurities are shown to be present besides the impurities which give the majority charge carriers. A measure of compensation is introduced as a compensation characteristic. Since many semiconductor devices contain heavily compensated parts, the problem of investigating semiconductor materials over a wide range of the degree of compensation is posed. A convenient method is given for compensating semiconductor materials based on the temperature dependence of the solubility of quickly diffusing impurities (copper). The results are given of an investigation into phenomena associated with the compensation of donors by acceptors in electron-type gallium arsenide and indium phosphide and in hole-type gallium arsenide. Author

N73-11762 National Lending Library for Science and Technology, Boston Spa (England).
THE POLARISATION DYNAMICS OF FERRO-ELECTRIC SOLID SOLUTIONS OF THE PEROVSKITE CLASS, OVER WIDE RANGES OF TEMPERATURE, VOLTAGE AND DURATION OF APPLICATION OF THE ELECTROSTATIC FIELD
A. E. Krumin Sep. 1972 51 p refs Transl. into ENGLISH from the publ. "Fazovye perekhody v segnetoelektrikakh" Riga, 1971 p 155-206
(NLL-RTS-7416) Avail: Natl. Lending Library, Boston Spa, Engl.: £5.00: 17 NLL photocopy coupons

The dynamics of polarization in polycrystalline ferroelectric materials are discussed, and the three basic forms of polarization which occur in ferroelectric ceramics (induced, domain orientation, and intergranular) are reviewed. Experimental measurements of polarization for several solid solutions are reported. It is concluded that polarization is due to two principle forms: domain reorientation and intergranular polarization. F.O.S.

N73-11763# Research Inst. of National Defence, Stockholm (Sweden).
SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES. 1: PROMISING DESIGNS FOR STABLE PARTLY RESISTIVE QUANTUM INTERFERENCE DEVICES AND AN EASILY CONSTRUCTED SUPERCONDUCTING QUANTUM INTERFERENCE DEVICE FOA Reports, Volume 6, No. 8, Jul. 1972
Bruno Slettenmark Jul. 1972 9 p refs
(FOA-2-B-2034-E1) Avail: NTIS HC $3.00

Stable C-shaped and symmetric dc and RF voltage-biased superconducting quantum interference devices (SQIDs) were designed and tested for different applications. An easily constructed RF SQID with the critical current of the point contact adjustable from outside the cryostat is described. General experience in constructing and operating the various devices is reported. Author

N73-11764# Research Inst. of National Defence, Stockholm (Sweden).
SUPERCONDUCTING QUANTUM INTERFERENCE DEVICES. 2: A MODEL FOR THE OPERATION OF A PARTLY RESISTIVE SUPERCONDUCTING POINT CONTACT QUANTUM INTERFERENCE DEVICE FOA Reports, Volume 6, No. 9, Aug. 1972
J. Gavin Park and Bruno Slettenmark Aug. 1972 14 p refs
(FOA-2-B-2035-E1) Avail: NTIS HC $3.00

A model for the operation of a partly resistive, superconducting point contact quantum interference device is presented. A general response function is calculated, and approximate expressions for the frequency dependence and noise properties at high and low frequencies are given. A partly resistive double-hole device is described, and the obtained experimental results are compared with the predictions of the model. The experimental observations agree quite well with the given model in all respects, allowing for one possible exception, where the observed noise signal appears to be about one order of magnitude smaller than expected. The model is also used to give a different interpretation of some published experimental observations on a resistive SQID. Author

N73-11765# Technische Universitaet, Brunswick (West Germany). Naturwissenschaftlichen Fakultaet.
THERMAL ABSORPTION OF GERMANIUM IN THE SPECTRUM REGION OF 0.5 TO 4.6 ELECTRON VOLTS Ph.D. Thesis [THERMOABSORPTION AN GERMANIUM IM SPEKTRALBEREICH VON 0,5-4, 6 eV]
Klaus Dettmer 28 May 1971 128 p refs In GERMAN
Avail: NTIS HC $8.50

Differential thermal absorption spectra are used to determine electron transitions in the Ge band structure. Observed are a ground level primary transfer with spin orbit decoupling in a 6100 A thick germanium film at room temperature, and transformations E sub 1 and e sub 1 in the (111) direction of the k-space for 500 A and 300 A thick Ge films. Correlation of the energy separation between the E sub 1 and e sub 1 transfers with the Lorentz temperature distribution function shows that 2 eV transfers are observable above room temperatures. Several peaks found above 2 eV cannot be attributed to E sub 2 transfers. Transl. by G.G.

N73-11766*# National Aeronautics and Space Administration, Washington, D.C.
ON THE SEMICONDUCTOR THEORY OF BARRIER LAYER AND POINT CONTACT RECTIFIERS
W. Schottky Sep. 1972 81 p refs Transl. into ENGLISH from the report of the Zentral-Abt. der Siemens and Halske A.G., Berlin-Siemensstadt 80 p
(NASA-TT-F-14708) Avail: NTIS HC $6.25 CSCL 20L

The physical processes in point-contact and dry rectifiers and their technological application are discussed along with the concepts from thermionics which have been transposed to the problem of electron transfer between metal and semiconductor. The boundary layer of impoverishment occurring at the metal electrode in the semiconductor, which is dominated by space-charge conditions is investigated. The assumptions of the space-charge theory are summarized. F.O.S.

N73-11767# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
DIFFUSION-ACCOMMODATED FLOW AND SUPERPLASTICITY
M. F. Ashby and R. A. Verrall Jun. 1972 50 p refs
(Contract N00014-67-A-0298-0020; NR Proj. 031-732)
(AD-746499; TR-6) Avail: NTIS CSCL 20/12

Polycrystalline matter can deform to large strains by grain-boundary sliding with diffusional accommodation. A new mechanism for this sort of deformation is described and modelled. It differs fundamentally from Nabarro-Herring and Coble creep in a topological sense: grains switch their neighbors, and do

not elongate significantly. A constitutive equation describing the mechanism is derived from the model. The strain-rate may be diffusion controlled, or it may be controlled by an interface reaction. The flow behavior of superplastic alloys can be explained as the superposition of this mechanism and ordinary power-law creep (dislocation creep). The combined mechanisms appear to be capable of explaining not only the observed relation between strain-rate and stress, but most of the microstructural and topological features of superplastic flow as well.
Author (GRA)

N73-11768# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
SPIN-FLIP RAMAN SCATTERING IN CADMIUM SULFIDE M.S. Thesis
Thomas Wain Walker Jun. 1972 85 p refs
(AD-746219; GEP/PH/72-23) Avail: NTIS CSCL 20/12

The 4880A line of an Argon laser was used to study the spin-flip Raman scattering in CdS at liquid helium temperature. The detection system utilized a Bausch and Lomb two meter spectrometer. The first high resolution photograph of Stokes spin-flip scattering in CdS was observed. The results with CdS indicate the feasibility of using this high resolution system in experiments with small g-factor materials such as GaAs, CdTe, and CdSe. The g-factor calculations for CdS give 1.54 at 83 KG, 1.62 at 91 KG and 1.74 at 96 KG. These results, in contrast with previous experimental data, give a smaller g-factor that varies with magnetic field. A possible explanation is that the spin-flip transition occurred in a donor level rather than the conduction band. The Stokes line was found to have a very narrow linewidth .33A, and its intensity was several orders of magnitude higher than the LO and TO phonons.
Author (GRA)

N73-11769# Florida Univ., Gainesville. Dept. of Engineering Science Mechanics and Aerospace Engineering.
RELATIONSHIPS BETWEEN CONTINUUM PLASTICITY AND PHENOMENOLOGICAL DISLOCATION THEORY Final Technical Report, Mar. 1971 - Jul. 1972
Craig S. Hartley and Martin A. Eisenberg Jul. 1972 43 p refs
(Contract N00014-68-A-0173-0002)
(AD-746187) Avail. NTIS CSCL 20/12

The kinematics of dislocated continua are used to develop correspondences between simple models of metals plastically deforming under multiaxial states of stress. Interpretations are offered to various material parameters and thermodynamic restrictions appearing in phenomenological plasticity theory. Thermally activated flow analysis is developed in a form suitable for use in analysis of plastic deformation under multiaxial states of stress. The results offer promise of allowing dislocation theoretic concepts to be incorporated into more realistic constitutive laws for use in continuum plasticity theories.
Author (GRA)

N73-11770# Naval Research Lab., Washington, D.C.
INFLUENCE OF THE ATMOSPHERE ON THE THERMOLUMINESCENCE OF A CRYSTALLINE POWDER
Dominique Lapraz, Philibert Iacconi, and Paul Keller 12 Jul. 1972 9 p refs Transl. into ENGLISH from J. Chim. Phys. (Paris), v. 68, 1971 p 1608-1610
(AD-746442; NRL-Trans-1254) Avail: NTIS CSCL 20/12

The note presents results relative to the effects of gaseous atmosphere and pressure on the natural thermoluminescence of a powdered crystalline sample. The authors demonstrate, in particular, that the peaks do not disappear at pressures below 0.01 torr, but that they are displaced towards higher temperatures. Further, at constant pressure, a peak displacement is observed which depends on the nature of the gas.
Author (GRA)

N73-11771# Queensland Univ., Brisbane (Australia). Dept. of Chemistry.
CHARGE AND ENERGY TRANSFER IN ORGANIC SYSTEMS Final Report, 1 Mar. 1965 - 30 Jun. 1972
Lawrence E. Lyons Jun. 1972 41 p refs
(Grant AF-AFOSR-1561-68; AF Proj. 9760)
(AD-745988; AFOSR-72-1290TR) Avail: NTIS CSCL 20/12

The report reviews the author's research on organic semiconductors. This includes energy gaps to the conduction band in aromatic hydrocarbon crystals, purity and perfection of crystals, electrical properties of anthracene crystals, and photoelectric properties of aromatic crystals.
GRA

N73-11772# Army Foreign Science and Technology Center, Charlottesville, Va.
PROPERTIES OF ALLOYS OF ZIRCONIUM AND NIOBIUM CARBIDES IN THEIR HOMOGENEITY DOMAIN
G. V. Samsonov 26 Jun. 1972 7 p refs Transl. into ENGLISH from Porosh. Met. (USSR), no. 2, 1971 p 85-88
(AD-746217; FSTC-HT-23-1558-72) Avail: NTIS CSCL 20/12

A study was made of specific electrical resistivity, thermal emf, the Hall coefficient, magnetic susceptibility, and also the temperature dependence of specific electrical resistivity and thermal emf (at 50 to 1000C) of binary solid solutions of the carbides of zirconium and niobium in their homogeneity domain. Extremal values of these properties are observed for an equimolar composition, which indicates the predominant role of the Zirconium-Niobium bond in the total bond energy when solid solutions are formed.
Author (GRA)

N73-11773# Idaho Univ., Moscow. Dept. of Physics.
PROPERTIES OF MG2SN Final Report, 29 Jan. 1969 - 30 Jun. 1972
R. J. Kearney Jul. 1972 10 p refs
(Contract DA-ARO(D)-31-124-G1101)
(AD-745942; AROD-7985-10-P) Avail: NTIS CSCL 20/12

The report summarizes a study of the properties of the semiconducting compound Mg2Sn. It includes a list of published articles and manuscripts submitted for publication, abstracts of submitted manuscripts are included.
Author (GRA)

N73-11774# Texas A&M Univ., College Station.
PROJECTILE PENETRATION THEORY
Louis J. Thompson and William R. Bryant 1972 9 p refs Presented at Conf. on Rapid Penetration of Terrestrial Mater., College Station, Tex., 1-3 Feb. 1972; Sponsored by ASCE Soil Mech. and Found. Div., Sandia Labs., Albuquerque, and Tex. Eng. Expt. Sta.
(Contract N00014-68-A-0308-0002)
(AD-746140; Contrib-492) Avail: NTIS CSCL 20/11

The article discusses a method of obtaining a solution to a non-conservative mechanics problem. When the method is applied to projectile penetration it yields the drag on the projectile as a function of depth, velocitym material properties and the imposed displacement boundary conditions for the surface of half space penetrated. The process probably can be assumed to be adiabatic since the event occurs so quickly. The deceleration predicted can be compared with those measured in both field and laboratory tests. The boundary motions must be those that have been observed in the field and laboratory studies.
GRA

N73-11775# Naval Postgraduate School, Monterey, Calif.
AN IMPROVEMENT OF SOUTHWELL'S METHOD FOR DETERMINING BUCKLING LOADS M.S. Thesis
Robert Paul Hendershot Jun. 1972 59 p refs
(AD-745881) Avail: NTIS CSCL 20/11

If an elastic bar with some initial imperfection is subjected to increasing compressive axial load, the lateral deflection, measured anywhere along its length, increases monotonically; the primary buckling mode becoming more and more dominant in the deflected shape. A classical approximate technique, due to R. V. Southwell, correlates axial load and lateral deflection for determination of the primary buckling load of the bar. However, Southwell's approximation may be inaccurate if the primary mode does not predominate in the deflected shape. The present thesis proposes a technique which employs axial loading, but also transverse loading to insure dominance of the primary mode in the deflected shape.
Author (GRA)

N73-11776# Virginia Polytechnic Inst. and State Univ., Blacksburg.
NONCRYSTALLINE SEMICONDUCTORS: ELECTRICAL AND THERMAL PROCESSES Semiannual Technical Report
Lyle E. Slack 1 Apr. 1972 53 p refs

(Contract DA-ARO(D)-31-124-72-G72; ARPA Order 1562)
(AD-746278) Avail: NTIS CSCL 20/12

During this first six months, the high speed switching in amorphous AsTe was characterized. Digital computer simulations of the Joule heating and heat transfer processes in amorphous semiconductor switches have been performed. The ESCA (Electron Spectroscopy for Chemical Analysis) equipment with an associated computer was installed and initial studies on amorphous semiconductors using this technique are described. GRA

N73-11777# Wyoming Univ., Laramie. Dept. of Physics and Astronomy.
DISLOCATION SCATTERING IN TEFLON AT LOW TEMPERATURES: OPTICAL AND MAGNETIC PROPERTIES OF SOME TRANSITION METAL IONS IN LITHIUM PHOSPHATE GLASS Annual Report, 1 Jul. 1971 - 30 Jun. 1972
Terry A. Scott, Monte M. Giles (Missouri Western Coll.), Manfred Berretz, and Smith L. Holt Jul. 1972 25 p refs
(Contract N00014-71-C-0388; NR Proj. 017-657)
(AD-746516) Avail: NTIS CSCL 20/12

The thermal conductivity of a sample of Teflon was measured in the temperature range 0.17 to 4.0 K. A good fit to these data was obtained by using dislocation scattering of phonons and a Debye omega squared frequency distribution. The optical and magnetic behavior of chromium and manganese ions doped into Li3PO4 glass is studied, as well as other transition metal ions. Author (GRA)

N73-11778# Westinghouse Research Labs., Pittsburgh, Pa.
PARAMAGNETIC HOLE CENTERS IN CeO2 Summary Report, 1 Jun. 1971 - 31 Jan. 1972
George R. Wagner and Joseph Murphy Wright-Patterson AFB, Ohio ARL Feb. 1972 40 p refs
(Contract F33615-68-C-1681; AF Proj. 7021)
(AD-746036; ARL-72-0024) Avail: NTIS CSCL 20/12

The ESR spectra of three hole centers were observed in nominally pure crystals of CeO2 following UV irradiation at 77 K. Designated V sub I, V sub II, and V sub III, the centers exhibit orthorhombic symmetry with principal axes (x,y,z) parallel to (110), (001), and (1,-1,0) respectively. The g-values are: g sub x (I) = 2.0311, g sub y (I) = 2.0065, g sub z (I) = 2.0330; g sub x (II) = 2.0175; g sub y (II) = 2.0054, g sub z (II) = 2.0317; and g sub x (III) = 2.0268, g sub y (III) = 2.0050, g sub z (III) = 2.0415. The V sub III center exhibits a hyperfine interaction with a nuclear spin I = 1/2 for which A sub x = 3.1, A sub y = 2.3, and A sub z = 2.7 in units of 0.0001/cm. The thermal bleaching of the centers was correlated with the thermoluminescence of the same crystals measured by Land and Rodine. Models for these centers are proposed which involve an O2 (3-) molecular ion near a stabilizing impurity ion. Author

N73-11779# Office of Naval Research, London (England).
VENICE FILM FAIR (1972 INTERNATIONAL CONFERENCE ON THIN FILMS)
William J. Condell 10 Jul. 1972 20 p refs Conf. held at San Giorgio Is., Italy, 15-19 May 1972
(AD-746719; ONRL-C-9-72) Avail: NTIS CSCL 20/12

The papers presented at the Venice International Conference on Thin Films (1972) are used to identify by country and institution research interests in thin films. Author (GRA)

N73-11780# Naval Postgraduate School, Monterey, Calif. Dept. of Physics.
A COMPUTER SIMULATION OF COPPER CRYSTAL SURFACE DYNAMICS M.S. Thesis
Henry William Sterbenz, Jr. Jun. 1972 141 p refs
(AD-745872) Avail: NTIS CSCL 20/2

A simple physical model of a copper crystal surface was developed. Atoms were considered as quasi-hard spheres which occupied perfect lattice positions. A computer simulation, based on energy consideration only, using the Monte Carlo method was developed, tested and used to study equilibrium surface microstates. Author (GRA)

N73-11781# Hewlett-Packard Co., Palo Alto, Calif.
MAGNETIC RARE EARTH COMPOUNDS Final Technical Report, 14 Jun. 1971 - 13 Jun. 1972
Robert A. Burmeister and Ronald Hiskes Jun. 1972 88 p refs
(Contract DAAH01-71-C-1259; ARPA Order 1627)
(AD-745903) Avail: NTIS CSCL 20/2

The magnetically uniaxial rare earth garnets (Eu, Er)3(Ga, Fe)5O12 and (Gd,Y,Yb)3 (Ga,Fe)5O12 have been grown on (111), Gd3Ga5O12 substrates by the liquid phase epitaxial dipping technique in both PbO-B2O3 and BaO-B2O3-BaF2 solvents. The BaO-based solvent has been characterized with respect to solubility and suitable growth parameters of the magnetic garnets. The substrate and magnetic films have been characterized with respect to compositional uniformity, lattice parameters, impurities, surface morphology, thickness uniformity and magnetic properties. Author (GRA)

N73-11782# Stanford Univ., Calif. Microwave Lab.
MICROWAVE ACOUSTIC AND BULK DEVICE TECHNIQUE STUDIES Technical Report, 1 Nov. 1971 - 30 Apr. 1972
Marvin Chodorow, H. J. Shaw, and John M. Borky Griffiss AFB, N. Y. RADC Jul. 1972 52 p refs
(Contract F30602-71-C-0125; AF Proj. 5573)
(AD-747047; ML-2050; RADC-TR-71-162) Avail: NTIS CSCL 20/12

The objectives of the contract are to advance new theory and device techniques for the generation and processing of microwave signals using elastic, electromagnetic, and carrier space charge waves in solid media. The work under the contract is presently divided into three projects; acoustic parametric interactions, wide bandwidth dispersive delay lines, and bulk and surface acoustic wave amplifiers. Author (GRA)

N73-11783# Stanford Univ., Calif.
SYNTHESIS OF COMPOUND SEMICONDUCTING MATERIALS AND DEVICE APPLICATIONS Final Report, 1 Jul. 1971 - 30 Jun. 1972
D. A. Stevenson 30 Jun. 1972 186 p refs
(Contract DAHC15-71-C-G-9; ARPA Order 1644)
(AD-746882; CMR-72-10) Avail: NTIS CSCL 20/12

Contents: Epitaxial crystal growth, Applications of compound semiconductor materials, Precipitation studies in compound semiconductors, Relations between dislocations and mechanical properties and the production and characterization of defect structures in compound semiconductors, Scientific aspects of semiconductor crystal preparation, Vapor-phase growth of AlN, GaN and AlN-GaN solid solutions. GRA

N73-11784# Martin Marietta Corp., Baltimore, Md.
AN ATOMISTIC APPROACH TO FRACTURE MECHANICS Final Report
Norman H. MacMillan Jul. 1972 162 p refs
(Contract F44620-C-70-0097)
(AD-746711; AFOSR-TR-72-1349) Avail: NTIS CSCL 20/12

It is possible that accurate atomic models of the regions at the tips of cracks in stressed materials could provide greater insight into the fundamentals of the fracture process than has been obtained from the continuum models employed hitherto. Accordingly, a study has been made of the problems of constructing such atomic models. Several common interatomic potentials have been examined to determine their suitability for such an application, and numerical methods of obtaining crack tip structures from the most suitable of these have been developed and programmed. A few preliminary crack tips have been modelled to demonstrate the validity of the atomistic approach. Author (GRA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N73-11785*# Southwest Research Inst., San Antonio, Tex. Hydro-Mechanical Systems.
ANALYSIS OF PROPELLANT FEEDLINE DYNAMICS Interim Technical Report
W. J. Asteleford, J. H. Holster, and C. R. Gerlach Aug. 1972

131 p refs
(Contract NAS8-25919; SwRI Proj. 02-2889)
(NASA-CR-123913; ITR-1) Avail: NTIS HC $8.75 CSCL 21I

An analytical model and computer program were developed for studying the disturbances of liquid propellants in engine feedline systems. It was found that the predominant effect of turbulence is to increase the spatial attenuation at low frequencies; at high frequencies the laminar and turbulent frequencies coincide. Recommendations for future work are included. F.O.S.

N73-11786# Defence Standards Labs., Maribyrnong (Australia).
THE DETERMINATION OF DIPHENYLAMINE AND ETHYL CENTRALITE IN TYPE AR5401 PROPELLANT
R. G. Davidson and A. G. Kelso Aug. 1972 17 p refs
(TN-267) Avail: NTIS HC $3.00

The determination of diphenylamine and ethyl centralite in propellant AR5401 by various methods has been examined. Separation from the propellant base (nitrocellulose) was effected by both solvent extraction and steam distillation. UV absorption, gas-liquid chromatography and gravimetric analysis were all subsequently used to analyse the separated material. The results have been discussed in terms of the applicability of each method to the analysis of both fresh and aged propellants. Author

N73-11787# Technological Lab. RVO-TNO, Rijswijk (Netherlands).
THE EXOTHERMAL REACTION BETWEEN NITROGUANIDINE AND NITROGEN DIOXIDE
23 Jun. 1972 9 p ref
(TDCK-60180) Avail: NTIS HC $3.00

The reaction between NGu and NO2 was investigated with the MES (measurement of the effective stabilizer) apparatus using a sample of sand on which 2.52% of NGu was precipitated. At 40 C the reaction was rather slow and much heat was lost to the surroundings. By increasing the starting temperature the reaction velocity was considerably enhanced. At 98 C a temperature rise of 58.7 C was reached within 2 minutes and this value was used to calculate the heat of the NGu-NO2 reaction. The calculated value of 46 kcal/mole is sufficient to explain the explosion during the MES experiment with the triple base propellant. Author

N73-11788*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SURVEY OF MATERIALS FOR HYDRAZINE PROPULSION SYSTEMS IN MULTICYCLE EXTENDED LIFE APPLICATIONS
C. D. Coulbert and G. Yankura 15 Sep. 1972 144 p refs
(Contract NAS7-100)
(NASA-CR-128491; JPL-TM-33-561) Avail: NTIS HC $9.25 CSCL 20I

An assessment is presented of materials compatibility data for hydrazine monopropellant propulsion systems applicable to the Space Shuttle vehicle missions. Materials were evaluated for application over a 10-yr/100-mission operational lifetime with minimum refurbishment. A general materials compatibility rating for a broad range of materials and several propellants based primarily on static liquid propellant immersion testing and an in-depth evaluation of hydrazine decomposition as a function of purity, temperature, material, surface conditions, etc., are presented. The most promising polymeric material candidates for propellant diaphragms and seals appear to have little effect on increasing hydrazine decomposition rates, but the materials themselves do undergo changes in physical properties which can affect their 10-yr performance in multicycle applications. The available data on these physical properties of elastomeric materials as affected by exposure to hydrazine or related environments are presented. Author

N73-11789# Lockheed Propulsion Co., Redlands, Calif.
HTPB POLYMER IMPROVEMENT Technical Summary Report, 15 Dec. 1971 - 30 Apr. 1972
W. E. Baumgartner and G. E. Myers Jun. 1972 74 p refs
(Contract F04611-72-C-0038)
(AD-746338; LPC-625-I-1; AFRPL-TR-72-50; TSR-1) Avail: NTIS CSCL 21/9

A series of fourteen experimental R-45 HTPB prepolymers was prepared in an effort to produce an optimum HTPB prepolymer for application in solid propellants. The materials, representative of a range of process conditions, ranged in number average molecular weight from 1800 to 6000, with functionality ranging from 2.0 to 2.7. Polymer and propellant mix viscosity were shown to be related to prepolymer molecular weight, and potlife generally increased with the equivalent weight. The rather wide variations in prepolymer structural properties, however, were not clearly reflected in significant differences in propellant uniaxial tensile properties. Three lots were selected for scale-up processing to permit more detailed evaluation in highly solids loaded HTPB propellant. Author (GRA)

N73-11790# Air Force Rocket Propulsion Lab., Edwards AFB, Calif.
THE SYNTHESIS AND CHARACTERIZATION OF 4,5-DICYANO OXAZOLE, A LOW HYDROGEN CONTENT FUEL Final Report, Nov. 1971 - Jun. 1972
Claude I. Merrill and Richard N. Watson Jun. 1972 19 p refs
(AF Proj. 573006 CL)
(AD-746342; AFRPL-TR-72-68) Avail: NTIS CSCL 07/3

A requirement exists for improved reactant candidates for use in gas dynamic lasers (GDL). Propellants are needed which satisfy the basic composition and flame temperature criteria of the GDL application, and also would be practicable in an operational environment. As a possible fuel, 4,5-dicyano oxazole, was suggested for evaluation. The successful synthesis and subsequent characterization of 4,5-dicyano oxazole are presented herein. GRA

N73-11791# Army Coating and Chemical Lab., Aberdeen Proving Ground, Md.
ANALYTICAL METHOD FOR ETHYLENE DIBROMIDE DEPLETION IN AVIATION GASOLINE Final Report
George G. Esposito May 1972 12 p ref
(DA Proj. 1T0-62105-A-329)
(AD-746250; CCL-304) Avail: NTIS CSCL 21/4

The measurement of ethylene dibromide depletion in aviation gasoline is one criterion for evaluating the storage stability of coatings used for the corrosion prevention of tanks and containers used for the storage and protection of military petroleum based hydrocarbons fuels. The standard procedure for the determination of ethylene dibromide depletion is time-consuming, requires special equipment, and necessitates extraordinary care in handling. The method described affords an accurate, uninvolved procedure for measuring ethylene dibromide depletion; the procedure is free from hazardous operating conditions and is highly reproducible. It is based on the following reactions: BrCH2CH2Br over KOH yields CH2 = CHBr and BrCH2CH2Br + KOH yields CH2 = CHBr + KBr + H2O, then AgNO3 + KBr yields AgBr precipitate. Author (GRA)

N73-11792# California Univ., Berkeley. Dept. of Chemical Engineering.
DECOMPOSITION KINETICS OF THE ROCKET OXIDIZER AMMONIUM PERCHLORATE Final Report
F. Shadman-Yazdi and Eugene E. Petersen 31 Mar. 1972 85 p refs
(Contract AF-AFOSR-1458-68; AF Proj. 9750)
(AD-746728; AFOSR-72-1357TR) Avail: NTIS CSCL 21/9

The effects of catalysts on the deflagration pressure-limit and the burning rate of ammonium perchlorate was studied. The catalysts used were copper chromite, ferric oxide, cupric oxide and potassium permanganate. Copper chromite, Fe2O3, and CuO increased the lower pressure limit of deflagration when present at small concentrations and decreased it at large concentrations. Potassium permanganate, both mechanically mixed and co-crystallized with ammonium perchlorate, had a similar effect on the lower pressure limit. However, at large concentrations of KMnO4, an upper pressure limit was observed above which deflagration could not be maintained. Catalysts were much more effective at smaller particle sizes. The effect of these catalysts on the burning rate was a function of the pressure. Author (GRA)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N73-11793*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FLIGHT INVESTIGATION OF AN UNDERWING NACELLE INSTALLATION OF AN AUXILIARY-INLET EJECTOR NOZZLE WITH A CLAMSHELL FLOW DIVERTER FROM MACH 0.6 TO 1.3
Verlon L. Head Washington Nov. 1972 39 p refs
(NASA-TM-X-2655; E-7042) Avail: NTIS HC $3.00 CSCL 21A

A nozzle installation of general interest is a podded engine mounted near the aft lower surface of the wing. The effect of this installation on the performance of an auxiliary-inlet ejector nozzle with a clamshell flow diverter was investigated over a Mach number range of 0.6 to 1.3 by using a modified F-106B aircraft. The clamshell flow diverter was tested in a 17 deg position with double-hinged synchronized floating doors. The ejector nozzle trailing-edge flaps were simulated in the closed position with a rigid structure which provided a boattail angle of 10 deg. Primary nozzle area was varied as exhaust gas temperature was varied between 975 and 1561 K. With the nozzle in a subsonic cruise position, the nozzle gross thrust coefficient was 0.918 at a flight Mach number of 0.9. Author

N73-11794*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATIONAL PROCEDURE FOR COMPUTER PROGRAM FOR DESIGN POINT CHARACTERISTICS OF A GAS GENERATOR OR A TURBOJET LIFT ENGINE FOR V/STOL APPLICATIONS
Richard P. Krebs Washington Nov. 1972 36 p refs
(NASA-TM-X-2656; E-6968) Avail: NTIS HC $3.00 CSCL 21E

The computer program described calculates the design-point characteristics of a gas generator or a turbojet lift engine for V/STOL applications. The program computes the dimensions and mass, as well as the thermodynamic performance of the model engine and its components. The program was written in FORTRAN 4 language. Provision has been made so that the program accepts input values in either SI Units or U.S. Customary Units. Each engine design-point calculation requires less than 0.5 second of 7094 computer time. Author

N73-11795*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DEVELOPMENT AND IN-FLIGHT PERFORMANCE OF THE MARINER 9 SPACECRAFT PROPULSION SYSTEM
D. D. Evans, R. D. Cannova, and M. J. Cork 1 Nov. 1972 36 p refs
(Contract NAS7-100)
(NASA-CR-129097; JPL-TM-33-574) Avail: NTIS HC $4.00 CSCL 21H

On November 14, 1971, Mariner 9 was decelerated into orbit about Mars by a 1334-newton (300-lbf) liquid bipropellant propulsion system. The development and in-flight performance are described and summarized of this pressure-fed, nitrogen tetroxide/monomethyl hydrazine bipropellant system. The design of all Mariner propulsion subsystems has been predicated upon the premise that simplicity of approach, coupled with thorough qualification and margin-limits testing, is the key to cost-effective reliability. The qualification test program and analytical modeling of the Mariner 9 subsystem are discussed. Since the propulsion subsystem is modular in nature, it was completely checked, serviced, and tested independent of the spacecraft. Proper prediction of in-flight performance required the development of three significant modeling tools to predict and account for nitrogen saturation of the propellant during the six-month coast period and to predict and statistically analyze in-flight data. The flight performance of the subsystem was excellent, as were the performance prediction correlations. These correlations are presented. Author

N73-11796*# Ceramic Finishing Co., State College, Pa.
STRENGTHENING OF OXIDATION RESISTANT MATERIALS FOR GAS TURBINE APPLICATIONS
D. R. Platts, H. P. Kirchner, and R. M. Gruver Sep. 1972 67 p refs
(Contract NAS3-15561)
(NASA-CR-121002) Avail: NTIS HC $5.50 CSCL 21E

Compressive surface layers were formed on hot-pressed silicon carbide and nitride. The objective of these treatments was to improve the impact resistance of these materials at 1590 K (2400 F). Quenching was used to form compressive surface layers on silicon carbide. The presence of the compressive stresses was demonstrated by slotted rod tests. Compressive stresses were retained at elevated temperatures. Improvements in impact resistance at 1590 K (2400 F) and flexural strength at room temperature were achieved using cylindrical rods 3.3 mm (0.13 in.) in diameter. Carburizing treatments were used to form the surface layers on silicon nitride. In a few cases using rectangular bars improvements in impact resistance at 1590 K (2400 F) were observed. Author

N73-11797*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
METHODS FOR REDUCING BLADE PASSING FREQUENCY NOISE GENERATED BY ROTOR-WAKE - STATOR INTERACTION
James H. Dittmar Washington Nov. 1972 32 p refs
(NASA-TM-X-2669; E-7066) Avail: NTIS HC $3.00 CSCL 21E

A theoretical model for the generation of blade-passage noise caused by the interaction of rotor wakes with the downstream stator blades in a fan stage has been compiled. This model has combined a description of the rotor wake based on existing experimental correlations with an existing theory for the response of the stator blades to those wakes. This model of the interaction-caused blade-passage noise has been used to examine some effects of blade geometry and flow conditions on the noise generated. A set of significant parameters has been identified to reduce this interaction-caused blade-passage frequency noise. A redesign of an existing fan with the use of these concepts has produced a theoretical noise reduction of more than 7 decibels. Author

N73-11798*# TRW Systems Group, Redondo Beach, Calif.
STUDY TO ADAPT SOLAR ELECTRIC PROPULSION TO THE PIONEER F AND G SPACECRAFT Final Report
15 Oct. 1972 244 p refs
(Contract NAS2-6796)
(NASA-CR-114514; TRW-22125-6001-R0-00) Avail: NTIS HC $14.25 CSCL 21C

The addition of an electric thrust subsystem to the spin-stabilized Pioneer F and G spacecraft to improve performance capability for certain missions is discussed. The evaluation was performed for the Atlas and Titan launch vehicles with Centaur and TE-364-4 stages and for electric thrust stages of 8- and 5-kw with three 30- and five 15-cm thrusters respectively. The combination of a spinning spacecraft with electric propulsion is a concept only recently evaluated and the penalty from spinning over three-axis stabilized is not as significant as might initally be thought. There are major gains in weight, cost, and reliability, the disadvantages being lower data rate during the thrust phase and less efficient pointing. A variety of missions were evaluated from a solar approach mission into 0.14 AU to a flyby mission of Neptune at approximately 30 AU. Performance improvements were present for all missions evaluated. Author

N73-11799*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
EXPERIMENTAL QUIET ENGINE PROGRAM AERODYNAMIC PERFORMANCE OF FAN C
R. G. Giffin, D. E. Parker, and L. W. Dunbar Aug. 1972 153 p refs
(Contract NAS3-12430)
(NASA-CR-120981) Avail: NTIS HC $9.75 CSCL 21E

This report presents the aerodynamic component test results

of Fan C, a high-bypass-ratio, low-aerodynamic-loading, 1550 feet per second (472.4 m/sec), single-stage fan, which was designed and tested as part of the NASA Experimental Quiet Engine Program. The fan was designed to deliver a bypass pressure ratio of 1.60 with an adiabatic efficiency of 84.2 percent at a total fan flow of 915 lb/sec (415.0 kg/sec). It was tested with and without inlet distortion. A bypass total-pressure ratio of 1.61 and an adiabatic efficiency of 83.9 percent at a total fan flow of 921 lb/sec (417.8 kg/sec) were actually achieved. An operating margin in excess of 14.6 percent was demonstrated at design speed. Author

N73-11800*# General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.
PROPULSION SYSTEM STUDIES FOR AN ADVANCED HIGH SUBSONIC, LONG RANGE JET COMMERCIAL TRANSPORT AIRCRAFT
Nov. 1972 152 p
(Contract NAS3-15544)
(NASA-CR-121016; R72-AEG-296) Avail: NTIS HC $9.75 CSCL 21A

Propulsion system characteristics for a long range, high subsonic (Mach 0.90 - 0.98), jet commercial transport aircraft are studied to identify the most desirable cycle and engine configuration and to assess the payoff of advanced engine technologies applicable to the time frame of the late 1970s to the mid 1980s. An engine parametric study phase examines major cycle trends on the basis of aircraft economics. This is followed by the preliminary design of two advanced mixed exhaust turbofan engines pointed at two different technology levels (1970 and 1985 commercial certification for engines No. 1 and No. 2, respectively). The economic penalties of environmental constraints - noise and exhaust emissions - are assessed. The highest specific thrust engine (lowest bypass ratio for a given core technology) achievable with a single-stage fan yields the best economics for a Mach 0.95 - 0.98 aircraft and can meet the noise objectives specified, but with significant economic penalties. Advanced technologies which would allow high temperature and cycle pressure ratios to be used effectively are shown to provide significant improvement in mission performance which can partially offset the economic penalties incurred to meet lower noise goals. Advanced technology needs are identified; and, in particular, the initiation of an integrated fan and inlet aero/acoustic program is recommended. Author

N73-11801*# Translation Consultants, Ltd., Arlington, Va.
THE EFFECTIVENESS OF DIFFUSION METALLIZATION IN INCREASING THE LIFE OF GAS TURBINE ENGINE TURBINE BLADES
P. T. Kolomytsev, P. P. Lebedev, and L. A. Kostina Washington NASA Nov. 1972 8 p Transl. into ENGLISH from Zashchitnyye Pokrytiya na Metallakh (USSR), no. 4, 1971 p 257-263
(Contract NASw-2038)
(NASA-TT-F-13914) Avail: NTIS HC $3.00 CSCL 21E

The use of diffusion metallization by chromium and aluminum to increase the longevity of parts made of heat-resistant materials at a comparatively low operating temperature (750 C) is considered. The efficiency of the turbine blades of the VK-1A engine was estimated from the results of full-scale tests of the endurance of uncoated and chromoaluminized blades after various times of operation. It is shown that in-vacuum chromoaluminizing increases the operating life of these turbine blades, the endurance limit being increased from 650 to 1300 hr. Author

N73-11802*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
A 200-HOUR DURABILITY TEST OF A 5-CENTIMETER DIAMETER MERCURY BOMBARDMENT ION THRUSTER
S. Nakanishi and R. C. Finke Oct. 1972 47 p refs
(NASA-TM-X-68155) Avail: NTIS HC $4.50 CSCL 21C

A 2000-hour durability test of a modified Hughes SIT-5 (Structurally Integrated Thruster, 5 cm) was conducted at the Lewis Research Center. The thruster operated with a translating screen thrust vector grid locked in position for 10 deg beam deflection. The test was essentially continuous except for seven stoppages of beam current. The neutralizer keeper voltage and thruster floating potential increased slightly with time. Performance profiles and maps of thruster characteristics were obtained at 453 and 2023 hours into the test. Overall efficiency was nearly constant at 31 - 32 percent, and operating characteristics were similar at both points in the test. A post-shutdown inspection showed negligible erosion damage to the accelerator and cathode baffle. Some erosion was found in the aperture of the neutralizer cathode. Author

N73-11803*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AERODYNAMIC STUDY OF A TURBINE DESIGNED FOR A SMALL LOW-COST TURBOFAN ENGINE
Milton G. Kofskey and William J. Nusbaum 1972 24 p refs To be presented at Gas Turbine Ann. Conf. and Products Show, Washington, D. C., 8-12 Apr. 1973; sponsored by ASME
(NASA-TM-X-68157; E-6850) Avail: NTIS HC $3.25 CSCL 21E

An eight inch mean diameter two-stage turbine was experimentally investigated over a range of speeds from 0 to 110 percent of equivalent design speed and over a range of pressure ratios from 2.2 to 4.2. The principal results indicated that the performance level was substantially higher than that assumed in the design. As part of the program to reduce manufacturing costs, the first stage blading was reduced in thickness for ease in coining. Tests of the modified blades indicated that the aerodynamic performance of a stator or rotor blade with a large amount of reaction was effected very little by a significant change of the pressure surface. Author

N73-11804*# TRW Systems Group, Redondo Beach, Calif.
DEVELOPMENT OF A MULTIKILOWATT ION THRUSTER POWER PROCESSOR
A. D. Schoenfeld, D. S. Goldin, and J. J. Biess Nov. 1972 177 p refs
(Contract NAS12-2183)
(NASA-CR-120928) Avail: NTIS HC $11.00 CSCL 21C

A feasibility study was made of the application of silicon-controlled, rectifier series, resonant inverter, power conditioning technology to electric propulsion power processing operating from a 200 to 400 Vdc solar array bus. A power system block diagram was generated to meet the electrical requirements of a 20 CM hollow cathode, mercury bombardment, ion engine. The SCR series resonant inverter was developed as a primary means of power switching and conversion, and the analog signal-to-discrete-time-interval converter control system was applied to achieve good regulation. A complete breadboard was designed, fabricated, and tested with a resistive load bank, and critical power processor areas relating to efficiency, weight, and part count were identified. Author

N73-11805*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF FUEL NOZZLE DESIGN ON PERFORMANCE OF AN EXPERIMENTAL ANNULAR COMBUSTOR USING NATURAL GAS FUEL
Jerrold D. Wear and Donald F. Schultz Washington Nov. 1972 50 p refs
(NASA-TN-D-7072; E-6459) Avail: NTIS HC $3.00 CSCL 21E

Tests of various fuel nozzles were conducted with natural gas fuel in a full-annulus combustor. The nozzles were designed to provide either axial, angled, or radial fuel injection. Each fuel nozzle was evaluated by measuring combustion efficiency at relatively severe combustor operating conditions. Combustor blowout and altitude ignition tests were also used to evaluate nozzle designs. Results indicate that angled injection gave higher combustion efficiency, less tendency toward combustion instability, and altitude relight characteristics equal to or superior to those of the other fuel nozzles that were tested. Author

N73-11806# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Brunswick (West Germany). Abteilung Strahldeflexion.
THE RECIRCULATION FLOW PATTERN OF A VTOL LIFT ENGINE Ph.D. Thesis - Brunswick Univ. [DAS REZIRKULATIONSSTROEMUNGSFELD EINES VTOL-HUBTRIEBWERKS]
Eckart Schwantes Jul. 1972 169 p refs In GERMAN; ENGLISH summary
(DLR-FB-72-50) Avail: NTIS HC $10.50

A method was developed to predict theoretically the increase in temperature due to wind recirculation in the inlet of a VTOL lift engine exhaust discharging downward toward the ground. Calculation of the velocities in the recirculation flow and determination of the temperatures using the laws of spread of buoyant plumes, are presented with regard to potential theory. Model investigations were carried out to check the results. The three regions of a VTOL propulsion jet (the free jet, the wall jet, and the zone of separation of the wall jet from the ground due to wind effects and buoyancy forces) were investigated using model jets with critical nozzle pressure ratio and temperatures up to 1000 C. Author (ESRO)

N73-11807# Naval Weapons Center, China Lake, Calif.
INTERACTIONS BETWEEN THE FLOW FIELD, COMBUSTION, AND WAVE MOTIONS IN ROCKET MOTORS
F. E. C. Culick Jun. 1972 79 p refs
(AD-746132; NWC-TP-5349) Avail: NTIS CSCL 21/8

The stability of small amplitude oscillations in combustion chambers is analyzed for one- and three-dimensional problems. In addition to combustion and mass addition at the boundaries, residual combustion and the presence of particulate matter within the chamber are accounted for. The results for the one-dimensional problem introduce new contributions, to the balance of acoustic energy, associated essentially with boundary layer processes acting if there is a component of acoustical motion parallel to the surface. These are incorporated in the general three-dimensional problem, and are shown to have a significant influence on the predicted stability of motions in a rocket motor. Author (GRA)

N73-11808# United Aircraft Corp., East Hartford, Conn. Research Labs.
ELECTROLYTIC IGNITION SYSTEM FOR A MILLIPOUND THRUSTER Final Report, 15 Jul. 1970 - 15 Jun. 1972
Charles T. Brown, D. G. McMahon, S. Russell, T. Fondrk, and I. Reed Jun. 1972 190 p refs
(AD-745993; AFRPL-TR-72-26) Avail: NTIS CSCL 21/8

The research had as its objective the development of an electrolytic ignition system for monopropellant-fueled millipound thrusters. The report describes the electrochemical decomposition of hydrazine-based monopropellants which was studied as a function of propellant composition and electrode materials. It was found that a 77% hydrazine-23% hydrazine azide composition yielded the highest heat output with the lowest power input provided platinum was used as an anode. Performance data was obtained on prototype engines incorporating the electrolytic ignition concept. GRA

N73-11809# ARO, Inc., Arnold Air Force Station, Tenn.
EVALUATION OF THE THIOKOL TE-M-521-5 APOGEE KICK MOTOR TESTED IN THE SPIN MODE AT SIMULATED ALTITUDE CONDITIONS Final Report
A. A. Cimino AEDC Aug. 1972 46 p refs
(Contract F40600-73-C-0004)
(AD-747018; ARO-ETF-TR-72-49; AEDC-TR-72-85) Avail: NTIS CSCL 21/8

One Thiokol Chemical Corporation TE-M-521-5 solid-propellant apogee rocket motor was successfully fired at an average simulated altitude of about 108,000 ft while spinning at 46 rpm. The primary program objectives were to determine vacuum ballistic performance of the motor which was temperature conditioned at 40F, determine altitude ignition characteristics, evaluate motor structural integrity, and determine motor-spacecraft temperature-time history during and after motor operation. Additional objectives were to measure the lateral (nonaxial) thrust component during motor operation and to measure radiation heat flux in the vicinity of the nozzle exit plane. Author (GRA)

N73-11810# ARO, Inc., Arnold Air Force Station, Tenn.
A DESIGN STUDY FOR TOXIC ROCKET EXHAUST GAS CLEANING Final Report, 15 Sep. 1970 - 15 May 1971
J. W. Garrett AEDC Aug. 1972 240 p refs
(Contract F40600-73-C-0004)
(AD-747023; ARO-ETF-TR-72-38; AFRPL-TR-72-32; AEDC-TR-72-97) Avail: NTIS CSCL 21/8

A literature and equipment survey resulted in the selection of a high gas velocity chemical spray scrubber as the method for cleaning toxic products from rocket exhaust gases. The study included application of this type of system to 1,000-, 5,000-, 50,000-, and 250,000-lb-thrust rockets. A pilot model system was designed (and specifications and drawings were prepared) for a 5,000-lb-thrust rocket engine. Author (GRA)

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics, and 24 Physics, Atomic, Molecular, and Nuclear.

N73-11811*# Avco Government Products Group, Lowell, Mass.
APPLICATION OF AVCO DATA ANALYSIS AND PREDICTION TECHNIQUES (ADAPT) TO PREDICTION OF SUNSPOT ACTIVITY Final Report
Herbert E. Hunter and Richard A. Amato Aug. 1972 212 p refs
(Contract NAS8-28087)
(NASA-CR-123925; AVSD-0287-72-CR) Avail: NTIS HC $12.75 CSCL 03B

The results are presented of the application of Avco Data Analysis and Prediction Techniques (ADAPT) to derivation of new algorithms for the prediction of future sunspot activity. The ADAPT derived algorithms show a factor of 2 to 3 reduction in the expected 2-sigma errors in the estimates of the 81-day running average of the Zurich sunspot numbers. The report presents: (1) the best estimates for sunspot cycles 20 and 21, (2) a comparison of the ADAPT performance with conventional techniques, and (3) specific approaches to further reduction in the errors of estimated sunspot activity and to recovery of earlier sunspot historical data. The ADAPT programs are used both to derive regression algorithm for prediction of the entire 11-year sunspot cycle from the preceding two cycles and to derive extrapolation algorithms for extrapolating a given sunspot cycle based on any available portion of the cycle. Author

N73-11812*# National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
THE INTERSTELLAR LINE SPECTRA OF ZETA OPHIUCHI AND ZETA PERSEI AND THEIR RELATION TO THE SHORT WAVELENGTH MICROWAVE BACKGROUND RADIATION Ph.D. Thesis - N. Y. Univ.
Victor John Bortolot, Jr. Jun. 1972 123 p refs
(NASA-TM-X-66073; X-630-72-206) Avail: NTIS HC $8.25 CSCL 03B

Thirty-one high dispersion Coude spectrograms of zeta Ophiuchi and seven of zeta Persei were numerically synthesized to produce high resolution, low noise spectra in the interval 3650 A to 4350 that yield data on atomic and molecular absorption in well-defined regions of the interstellar medium. The detection threshold is improved by as much as a factor 5 over single plates. Several interstellar lines were discovered in the zeta Oph - 15km/sec cloud and the zeta Per + 13 km/sec cloud. Author

N73-11813*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR WIND INTERACTION WITH COMET BENNETT (1969)
L. F. Burlaga, J. Rahe (Technische Univ., Berlin, West Ger.), B. D. Donn, and M. Neugebauer (JPL) Nov. 1972 29 p refs Submitted for publication
(Grant NGL-21-002-033)
(NASA-TM-X-66087; X-692-72-415) Avail: NTIS HC $3.50 CSCL 03B

The relations are examined between the solar-wind and Comet Bennett during the period 23 March to 5 April 1970. A large kink was observed in the ion tail of the comet on April 4, but no solar wind stream was observed in the ecliptic plane which could have caused the kink. Thus, either there was no correlation between the solar wind at the earth and that at Comet Bennett (which was 40 deg above the ecliptic) or the kink was caused by something other than a high-speed stream. The fine structure visible in photographs of the kink favors the second of these

alternatives. It is shown that a shock probably passed through Comet Bennett on March 31, but no effect was seen in photographs of the comet. A stream preceded by another shock and a large abrupt change in momentum flux might have intercepted the comet between 24 March and 28 March, but again no effect was seen in photographs of the Comet. In view of these results, the possibility must be considered that a large, abrupt change in momentum flux of the solar-wind is neither necessary nor sufficient to cause a large kink in a comet tail.
Author

N73-11814*# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
SOLAR FLARE PREDICTIONS AND WARNINGS Final Report
K. P. White, III 1 Oct. 1972 40 p refs
(Contract NAS2-6654)
(NASA-CR-114511; ATR-73(7265)-1) Avail: NTIS HC $4.00 CSCL 03B

The real-time solar monitoring information supplied to support SPARCS equipped rocket launches, the routine collection and analysis of 3.3-mm solar radio maps, short-term flare forecasts based on these maps, longer-term forecasts based on the recurrence of active regions, and an extension of the flare forecasting technique are summarized. Forecasts for expectation of a solar flare of class > or = 2F are given and compared with observed flares. A total of 52 plage regions produced all the flares of class > or = 1N during the study period. The following results are indicated: of the total of 21 positive forecasts, 3 were correct and 18 were incorrect; of the total of 31 negative forecasts, 3 were incorrect and 28 were correct; of a total of 6 plage regions producing large flares, 3 were correctly forecast and 3 were missed; and of 46 regions not producing any large flares, 18 were incorrectly forecast and 28 were correctly forecast.
Author

N73-11815*# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
SOLAR FLARE FORECASTS BASED ON mm-WAVELENGTH MEASUREMENTS
K. P. White, III 25 Oct. 1972 40 p refs
(Contract NAS2-6654)
(NASA-CR-114510; ATR-73(8102)-4) Avail: NTIS HC $4.00 CSCL 03B

Solar radio temperature contour maps at a wavelength of 3.3 mm are analyzed to develop a method of forecasting solar flares of classes 1N and 1B. Fundamental to the analysis is the demonstration that most of the radio sources associated with the sunspot-plage systems are not spatially resolved by the radio telescope and, hence, only the peak temperature enhancements due to these local radio sources are employed. Evidence is presented indicating that flare-prone plage regions, which belong to recurrent families of flare-productive regions, exhibit a relationship between flare production and radio temperature characteristics considerably unlike that exhibited by virgin plage regions. The results are interpreted by means of graphs which permit the inference of class 1B or 1N flare probabilities based on the peak temperature enhancements measured at 3.3 mm. In particular, the forecast obtained is the probability that a given flare-prone plage region will produce a class 1B or 1N flare (two quoted probabilities) during the period of its disk transit.
Author

N73-11816*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
UK-5 VAN ALLEN BELT RADIATION EXPOSURE: A SPECIAL STUDY TO DETERMINE THE TRAPPED PARTICLE INTENSITIES ON THE UK-5 SATELLITE WITH SPATIAL MAPPING OF THE AMBIENT FLUX ENVIRONMENT
E. G. Stassinopoulos Oct. 1972 226 p
(NASA-TM-X-66098; X-601-72-388) Avail: NTIS HC $13.50 CSCL 03B

Vehicle encountered electron and proton fluxes were calculated for a set of nominal UK-5 trajectories with new computational methods and new electron environment models. Temporal variations in the electron data were considered and partially accounted for. Field strength calculations were performed with an extrapolated model on the basis of linear secular variation predictions. Tabular maps for selected electron and proton energies were constructed as functions of latitude and longitude for specified altitudes. Orbital flux integration results are presented in graphical and tabular form; they are analyzed, explained, and discussed.
Author

N73-11817*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON GREENSTADT'S BINARY INDEX CRITERION
T. G. Northrop and T. J. Birmingham Nov. 1972 12 p ref
(NASA-TM-X-66105; X-640-72-425) Avail: NTIS HC $3.00 CSCL 03B

The Greenstadt-type criterion for distinguishing between laminar and pulsating (i.e., irregular) bow shock crossings can be expressed as a critical angle between the shock normal and the magnetic field. When the field is more tangent to the shock plane than this critical angle, the shock is laminar. More importantly, the requirement of Galilean invariance of the physics underlying such a criterion reveals that the Greenstadt p index must vary inversely as the solar wind velcoity.
Author

N73-11818*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE COSMIC GAMMA-RAY SPECTRUM BETWEEN 0.3 AND 27 MeV MEASURED ON THE APOLLO 15
J. I. Trombka, A. E. Metzger (JPL), J. R. Arnold (Calif. Univ., La Jolla), J. L. Matteson (Calif. Univ., La Jolla), R. C. Reedy (Calif. Univ., La. Jolla), and L. E. Peterson (Calif. Univ., La Jolla) Nov. 1972 23 p refs Submitted for publication
(NASA-TM-X-66104; X-641-72-421) Avail: NTIS HC $3.25 CSCL 03B

The spectrum of the total (diffuse and discrete sources) cosmic gamma-ray background over the 0.3 to 27 MeV range was measured with a 7.0 cm diameter x 7.0 cm long uncollimated NaI(Tl) scintillation counter located on a boom 7.6 m from the Apollo 15 service module. Data on cosmic gamma-rays were taken during transearth coast at various boom extensions, detector gains, and with the plastic anticoincidence scintillator enabled and disabled.
Author

N73-11819*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SOLAR WIND TEMPERATURE AND SPEED
L. F. Burlaga and K. W. Ogilvie Oct. 1972 25 p refs Submitted for publication
(NASA-TM-X-66091; X-692-72-175) Avail: NTIS HC $3.25 CSCL 03B

Averaging on a time scale of several solar rotations, the solar wind proton temperature, T, increases monotonically with bulk speed V. This macroscale T-V relation does not change appreciably with solar cycle. The temperatures corresponding to intervals of increasing speed are only approximately 15% higher than those corresponding to decreasing speeds, indicating that the macroscale T-V relation is not appreciably affected by stream interactions. On a time scale of a tenth of a solar rotation, there are time dependent T(t) - V(t) relations which are closely related to the stream profiles. These T(t) - V(t) relations can meaningfully be resolved into two components - the macroscale T-V relation and systematic, time-dependent deviations from the macroscale relation. These results support the view that the macroscale T-V relation is not appreciably affected by non-steady, interplanetary processes, but is determined rather by the proton heating mechanism.
Author

N73-11820# Lockheed Missiles and Space Co., Palo Alto, Calif.
VARIATIONS IN THE SOLAR WIND, MAGNETIC ACTIVITY, AND ELECTRONS PARAMETERS OF THE MAGNETOSPHERE TAIL AND THE OUTER RADIATION BELTS
K. G. Ivanov and N. V. Mikerina 1972 6 p refs Transl. into ENGLISH from Geomagnetism i Aeronomiya (Moscow), v. 12, no. 4, 1972 p 688-692
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The connection between variations in the solar wind parameters, the magnetosphere magnetic activity, and electrons for magnetospheric storms of July 7 through 12, 1966 and September 26, 1966 are presented. It is verified that variations in the southern component of the interplanetary magnetic F sub

S and the eastern component of electrical E sub E fields have the closest connection with the variations in the K sub p - index of the activity. Quantitatively these results agree with the consequences of the hypothesis of reconnection of the interplanetary and geomagnetic fields. Author

N73-11821# Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
STUDY OF THE HIGH ENERGY PROTON AND ELECTRON BEHAVIOR IN THE INNER MAGNETOSPHERE [UNTERSUCHUNGEN DES VERHALTENS HOCHENERGETISCHER PROTONEN UND ELEKTRONEN IN DER INNEREN MAGNETOSPHAERE]
B. Haeusler Apr. 1972 177 p refs In GERMAN
(MPI-PAE/Extraterr-66) Avail: NTIS HC $11.00

Measurements by proton and electron detectors, sensitive in the MeV range, onboard the German research satellite AZUR, in the radiation belt and over the polar cap are discussed. The objective is to come to conclusions regarding the source, loss, and transport processes of these particles within the geomagnetic field, and to behavior of the particles during geomagnetic disturbances. Author (ESRO)

N73-11822# Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.
GEOPHYSICS AND SPACE DATA BULLETIN. VOLUME 9, NUMBER 1: FIRST QUARTER 1972
Anne L. Carrigan Jun. 1972 318 p refs
(AF Proj. 8666)
(AD-746290; AFCRL-72-0327; AFCRL-SR-137) Avail: NTIS CSCL 03/2

This Bulletin is a quarterly publication that contains AFCRL contract and inhouse data reported from sites throughout the world. Program descriptions for all data sections are updated annually or as required, and are presented. The following types of data are contained within each issue: magnetometer, cosmic ray, ELF noise, riometer, solar optical and radio emission, and ionosonde. This issue covers such data for January, February, and March 1972. Author (GRA)

N73-11844* Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
TYPE 1 TAILS: SOLAR WIND INTERACTIONS
L. Biermann *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 59-64 refs (For availability see N73-11833 02-30)
CSCL 03B

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N73-11823*# IIT Research Inst., Chicago, Ill.
[INTERPLANETARY MISSION PLANNING] Final Report
Nov. 1971 113 p refs
(Contract NASw-2144)
(NASA-CR-129132; A-10) Avail: NTIS HC $7.75 CSCL 22A

A long range plan for solar system exploration is presented. The subjects discussed are: (1) science payload for first Jupiter orbiters, (2) Mercury orbiter mission study, (3) preliminary analysis of Uranus/Neptune entry probes for Grand Tour Missions, (4) comet rendezvous mission study, (5) a survey of interstellar missions, (6) a survey of candidate missions to explore rings of Saturn, and (7) preliminary analysis of Venus orbit radar missions. Author

N73-11824*# Chicago Univ., Ill. Enrico Fermi Inst. and Dept. of Physics.
DEFINITION PHASE STUDY OF THE GRAND TOUR MISSIONS Final Report
J. A. Simpson and Peter Meyer 6 Oct. 1972 45 p refs
(Grant NGR-14-001-196)
(NASA-CR-129182) Avail: NTIS HC $4.25 CSCL 22A

The research to define an energetic particle experiment for the OPTGT-MJS missions is reported. The studies reported include: (1) the use of silicon dectectors for low energy, low flux level measurements in the presence of RTG radiation and trapped electrons, (2) high energy proton damage of lithium-drifted and surface barrier silicon detectors, (3) the gas Cerenkov counter, (4) systems for detection of trapped high-energy protons in the presence of trapped electrons, and (5) reliability and redundancy. F.O.S.

N73-11825*# Drexel Univ., Philadelphia, Pa.
ACTIVITIES CONDUCTED DURING THE DEFINITION PHASE OF THE OUTER PLANETS MISSIONS PROGRAM Final Report
Oct. 1972 166 p refs
(Grant NGR-39-004-042)
(NASA-CR-129186) Avail: NTIS HC $10.50 CSCL 22A

The activities are described of the Meteoroid Science Team for the definition phase of the outer planet missions. Studies reported include: (1) combined zodiacal experiment for the Grand Tour Missions of the outer planets, (2) optical transmission of a honeycomb panel and its effectiveness as a particle impact surface, (3) element identification data from the combined zodiacal OPGT experiment and (4) development of lightweight thermally stable mirrors. F.O.S.

N73-11826*# IIT Research Inst., Chicago, Ill. Astro Sciences.
PLANETARY MISSION HANDBOOK. APPENDIX A: GRAPHICAL TRAJECTORY DATA
Jul. 1972 96 p
(Contract NASw-2144)
(NASA-CR-129162; T-32) Avail: NTIS HC $7.00 CSCL 22A

Graphical data is presented for Type 1 ballistic transfers to Jupiter (1974 to 1986), Saturn (1976 to 1986) and Uranus (1985). There are four graphs for each launch opportunity, namely the hyperbolic excess speed at earth departure, the hyperbolic excess speed at planet arrival, the declination of the hyperbolic departure asymptote, and the declination of the hyperbolic approach asymptote. Author

N73-11827*# Bureau of Mines, Minneapolis, Minn. Twin Cities Mining Research Center.
MULTIDISCIPLINARY RESEARCH LEADING TO UTILIZATION OF EXTRATERRESTRIAL RESOURCES Annual Status Report, fiscal year 1972
1972 15 p
(NASA Order R-09-040-001)
(NASA-CR-129109) Avail: NTIS HC $3.00 CSCL 03B

Progress of the research accomplished during fiscal year 1972 is reported. The summaries presented include: (1) background analysis and coordination, (2) surface properties of rock in simulated lunar environment, (3) rock failure processes, strength and elastic properties in simulated lunar environment, (4) thermal fragmentation, and thermophysical and optical properties in simulated lunar environment, and (5) use of explosives on the moon. F.O.S.

N73-11828*# Arizona Univ., Tucson.
GUEST OBSERVER PROGRAM OAO Final Report
George V. Coyne 29 Aug. 1972 2 p refs
(Grant NGR-03-002-193)
(NASA-CR-129166) Avail: NTIS HC $3.00 CSCL 03A

The OAO-A2 observations of two Be stars, 60 Cygnus and gamma Cassiopeia, were analyzed. It is shown that unpolarized radiation produced by continuous Balmer emission in the atmospheres of Be stars is significant in the explanation of the polarization observed below the Balmer discontinuity. Available multicolor polarimetry data was also analyzed with respect to interstellar polarization. K.P.D.

N73-11829*# Stanford Univ., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semiannual Status Report, 1 Jan. - 30 Jun. 1972
Jul. 1972 39 p refs
(Grant NGL-05-020-014; SEL-Proj. 3208)
(NASA-CR-129167; SASR-19) Avail: NTIS HC $4.00

CSCL 03A

The research is reported in the applications of radar and radio techniques to the study of the solar system, and to space programs. Experiments reported include: bistatic-radar on Apollo missions, development of an unmanned geophysical observatory in the Antarctic, Bragg scattering probes of sea states, characteristics of dense solar wind disturbances, and satellite communications for Alaska. F.O.S.

N73-11830*# Texas Univ., Austin. Applied Mechanics Research Lab.

A COMPARISON OF OPEN AND CLOSED LOOP APPLICATIONS OF THE MINIMUM DISTANCE GUIDANCE TECHNIQUE

James Padley Lattimore, Jr. May 1972 46 p refs
(Grant NGL-44-012-008)
(NASA-CR-129170; AMRL-1037) Avail: NTIS HC $4.50 CSCL 22A

A comparison is made of open and closed loop applications of a second order guidance algorithm, using the minimum distance strategy. A nonlinear reoptimization procedure is used as the ideal guidance history. The system model used for the comparison is a low-thrust vehicle performing a minimum time, three-dimensional, heliocentric Earth-Mars transfer. For the example problem considered, closed loop guidance proves to be much more accurate on satisfaction of the final state than the open loop procedure. On the other hand, closed loop guidance proves to be much more vulnerable to perturbation by highly nonlinear regions in the trajectory. Finally, the results indicate that for this problem the best loop closure interval is at each integration step, about one day, or more often, if possible. Author

N73-11831# Weapons Research Establishment, Salisbury (Australia).

KALMAN SMOOTHING OF CAMERA, RADAR, AND DOPPLER DATA TO CALCULATE A MISSILE TRAJECTORY

J. L. Roughan Jul. 1972 27 p refs
(WRE-TN-705(T)) Avail: NTIS HC $3.50

A method is described of using information from several cameras, radars, and Doppler receivers to produce a smoothed trajectory of a missile by the linear Kalman method. The observations are linearized and a simple linear model with noise in acceleration is assumed for the missile. Any suitable combination of instruments can be used for any section of the trajectory. Author

N73-11832# Dunsink Observatory, Dublin (Ireland).

PHOTOMETRIC STANDARDS IN THE MAGELLANIC CLOUDS Communications of the Dublin Inst. for Advanced Studies, Series C. Dunsink Observatory Publications, Volume 1, No. 6

C. J. Butler 1972 61 p refs
Avail: NTIS HC $5.25

Photoelectric UBVR and photographic UBV magnitudes are presented for standards in two regions in the LMC and one region in the SMC. Some tentative conclusions are drawn concerning the differences in the stellar population of the regions. Photometric spectral classification has been made for early type stars and the degree of interstellar reddening derived. From the derived spectral types and measured V-R colours it has been possible to evaluate the ratio of colour excesses E sub V-R over E sub B-V. All three regions show a higher value for this ratio than is normal within the Galaxy and this may indicate an unusual composition for the interstellar medium in the direction of the Magellanic Clouds. The ratio of E sub B-V to the number of hydrogen atoms in the line of sight is evaluated and discussed. Author

N73-11833*# Arizona Univ., Tucson. Lunar and Planetary Lab.

COMETS: SCIENTIFIC DATA AND MISSIONS

Gerard P. Kuiper, ed. and Elizabeth Roemer, ed. 1 Jul. 1972 226 p refs Presented at Tucson Comet Conf., Tucson, Ariz., 8-9 Apr. 1970 Revised Sponsored by NASA
(NASA-CR-129110; LC-72-619613) Avail: NTIS HC $13.50 CSCL 03B

The proceedings of the conference on comets are reported. Included are discussions of the observations of Comet Bennett. For individual titles, see N73-11834 through N73-11854.

N73-11834* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

INTRODUCTION: MISSION OPPORTUNITIES AND MODELS

N. Sirri *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 1-3 (For availability see N73-11833 02-30)
CSCL 03B

NASA's current plans and priorities through the mid-1980s are briefly presented including the fly-thru mission to Comet d'Arrest in 1976, Grand-Tour missions to the outer planets, and the Venus Explorer program. F.O.S.

N73-11835* Smithsonian Astrophysical Observatory, Cambridge, Mass.

COMETARY NUCLEI: MODELS

F. L. Whipple *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 4-15 refs (For availability see N73-11833 02-30)
CSCL 03B

Arguments for the existence of some kind of icy-conglomerate cometary nucleus are put forward, and the role of clathrates in the condensation of comets from the solar nebula is discussed. The division of cosmic materials into three types is described, and it is suggested that whereas Jupiter, and to a large extent Saturn, condensed directly from gas and the terrestrial planets and asteroids collected from planetesimals of earthy material, the comets were formed as snow balls in the vicinity of Uranus and Neptune, with these two planets themselves representing accumulations of comets. The evidence for the existence of a comet belt beyond Neptune is considered, and it is concluded that at 50 AU from the sun the mass of such a belt cannot be more than that of the Earth. Finally, some of the problems associated with the mission to periodic Comet d'Arrest are discussed, in particular those concerned with the detectability of the nucleus and the hazards of a close encounter. Author

N73-11836* Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

REALITY OF COMET NUCLEUS

R. A. Lyttleton *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 16-19 Prepared in Cooperation with St. John's Coll., Cambridge, England (For availability see N73-11833 02-30)
CSCL 03B

The structure of the cometary nucleus is discussed. The view that the comet is a vast swarm of tiny particles separated by large distances is defended by the argument that during the meteor showers of 1966, the earth intercepted thousands of millions of meteoric particles; however, no reports of a single meteorite reaching the ground were recorded. Another feature that indicates that a comet consists of a swarm of particles is that the comets contract as they approach the sun, and expand again as they recede. F.O.S.

N73-11837* Arizona Univ., Tucson. Lunar and Planetary Lab.

INFRARED MEASURES OF COMETS

T. Lee *In its* Comets: Sci. Data and Missions 1 Jul. 1972 p 20-22 refs (For availability see N73-11833 02-30)
CSCL 03B

Infrared observations of two comets, 1969g and 1969i, are presented. In both comets the infrared flux appears to be of thermal origin. The structure of the sources as well as the temperature, emissivity, and composition of the radiating material are discussed. Author

N73-11838* California Inst. of Tech., Pasadena.

INFRARED OBSERVATIONS OF COMETS IKEYA-SEKI (1965f) AND BENNETT (1969i)

J. A. Westphal *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 23-31 refs (For availability see N73-11833 02-30)
CSCL 03B

Measurements of Comet Bennett (1969i) from 1.2 microns to 10 microns indicate the presence of material at a temperature of 590 K on 6 April 1970. The excellence of the fit of the flux values to a 590 K blackbody severely restricts the possible range of materials present. Specifically it precludes simple isolated small

particle models to explain the excess temperature observed.
Author

N73-11839* Toledo Univ., Ohio.
NATURE AND ORIGIN OF COMETARY HEADS
A. H. Delsemme *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 32-47 refs (For availability see N73-11833 02-30)
CSCL 03B

In cometary spectra the three major constituents seem to be OH, H, and O. Their common precursor is likely to be water, whose rates of evaporation and dissociation have so far not led to a major discrepancy with the observations. This type of explanation, however, has not led to a positive identification of other parent molecules. With the known solar intensities, all the molecules that have been suggested, as NH3, CH4, etc, would lead to lifetimes one-to-two orders of magnitude larger than needed by the coma observations. An alternate hypothesis is that the precursors are not molecules, but icy particles stripped from the nucleus by the evaporating gases. By evaporating within an icy halo, the grains would liberate either parent molecules with very short lifetimes or some of the radicals themselves. Recent laboratory work suggests that the grains could be made of clathrate hydrates of gases or of radicals. The observations appear to indicate the presence of icy grains within the inner coma.
Author

N73-11840* Michigan Univ., Ann Arbor.
PHOTOMETRY OF COMETS c14
Freeman Miller *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 48-50 refs (For availability see N73-11833 02-30)
CSCL 14E

The photometric observations of comets are discussed in terms of providing profiles of the whole comet.
F.O.S.

N73-11841* National Aeronautics and Space Administration, Washington, D.C.
L ALPHA PHOTOMETRY OF COMET BENNETT c14
Maurice Dubin *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 51-54 refs (For availability see N73-11833 02-30)
CSCL 14E

Results of scanning Comet Bennett in L alpha from OGO-5 are reported. A plot of the comet isophotes in L alpha is presented. The outer envelope of the comet is approximately the 50-Rayleigh contour.
F.O.S.

N73-11842* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMMENTS ON PHOTOCHEMISTRY c14
B. D. Donn *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 55-56 refs (For availability see N73-11833 02-30)
CSCL 14E

Requirements for determining the source of C3 in comets are discussed, and include high resolution observation of the region near the nucleus, and near-continuous coverage.
F.O.S.

N73-11843* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FURTHER COMMENTS ON PHOTOCHEMISTRY c14
W. M. Jackson *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 57-58 ref (For availability see N73-11833 02-30)
CSCL 14E

The formation processes for C3 or C2 in comets are discussed along with the possibility of trapping the radical inside the clathrates.
F.O.S.

N73-11844* Max-Planck-Institut fuer Physik und Astrophysik, Munich (West Germany).
TYPE 1 TAILS: SOLAR WIND INTERACTIONS c29
L. Biermann *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 59-64 refs (For availability see N73-11833 02-30)
CSCL 03B

The ionization of the gas emitted by a comet is discussed along with the formation of a visible tail, and the bow shock front upstream toward the sun. Questions that a cometary probe can answer are listed.
F.O.S.

N73-11845* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
TYPE 1 TAILS: FURTHER COMMENTS
J. C. Brandt *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 65-68 refs (For availability see N73-11833 02-30)
CSCL 03B

A lecture on comet tails and the accompanying solar wind is presented. The possible use of a comet probe to determine the direction of the tail flow, solar wind fluctuations, and structure of the solar wind is explored.
E.H.W.

N73-11846* Massachusetts Inst. of Tech., Cambridge.
COMET TAILS OF TYPE 2
R. F. Probstein *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 69-83 refs (For availability see N73-11833 02-30)
CSCL 03B

A summary is presented of a theory for the head and tail regions of Type 2 (dust) comets, wherein dust particles having a wide distribution of sizes are assumed to be released from the comet nucleus in an essentially continuous manner in time during the period of distinctive cometary phenomena. The dust particles are assumed to be accelerated radially outward from the nucleus as a result of a drag interaction with the expanding gas in the comet head. In the tail region the only significant forces assumed to act on the dust particles are solar gravity and the force of solar radiation pressure. It is shown how results describing the surface density in the tail are obtained and how by matching calculated distributions with measured ones it is possible to determine the dust and head-gas emission rates as a function of time, the distribution of dust particle sizes, and the emission velocity from the inner head region as a function of particle size and time. The results of matching calculated density distributions with light intensity measurements from Comet Arend-Roland 1956h are summarized.
Author

N73-11847* Liege Univ. (Belgium).
COMET SPECTRA
C. Arpigny *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 84-111 refs (For availability see N73-11833 02-30)
CSCL 03B

The nature and chemical composition of comets as determined by their spectral energy distributions and polarization of the scattered radiation are discussed. The study is divided into two parts: (1) a description of the spectra and, (2) a discussion of the excitation mechanisms responsible for their production.
E.H.W.

N73-11848* California Inst. of Tech., Pasadena.
SPECTROSCOPIC OBSERVATIONS OF COMETS
T. C. Owen *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 112-121 (For availability see N73-11833 02-30)
CSCL 03A

The value of C-12/C-13 for the Comets Tago-Sato-Kosaka and Bennett was investigated. The values for both comets are presented in spectrographs.
E.H.W.

N73-11849* Smithsonian Astrophysical Observatory, Cambridge, Mass.
COMET ORBITS: PREDICTION, NONGRAVITATIONAL EFFECTS
B. G. Marsden *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 123-141 (For availability see N73-11833 02-30)
CSCL 03B

The problems of calculating cometary orbits are discussed, with particular attention to that of predicting the returns of periodic comets. It is shown that the only inherent difficulty arises from the action of nongravitational forces. Recent progress toward an understanding of these forces is described in detail, both from the point of view of fitting the observations and of interpreting the forces in terms of the Whipple icy-conglomerate model.
Author

N73-11850* Arizona Univ., Tucson. Lunar and Planetary Lab.
SHAPE AND ORIENTATION OF NUCLEUS
Tom Gehrels *In its* Comets: Sci. Data and Missions 1 Jul. 1972 p 142-144 refs (For availability see N73-11833 02-30)
CSCL 03B

The shape and rate of rotation, as determined from brightness-time variations of reflected sunlight, for various asteroid nuclei are presented. The possible application of such a technique to the nucleus of comets is discussed. E.H.W.

N73-11851* Harvard Coll. Observatory, Cambridge, Mass.
EVIDENCE FROM STREAM METEOROIDS
Richard McCrosky *In* Ariz. Univ. Comets: Sci. Data and Missions 1 Jul. 1972 p 145-151 refs (For availability see N73-11833 02-30)
CSCL 03B

The physical behavior and composition of shower meteors were examined in an effort to establish the structure of its parent comet. Properties considered include degree of fragmentation and density. E.H.W.

N73-11852* Toledo Univ., Ohio.
SOME SCIENTIFIC CRITERIA FOR A COMETARY MISSION
A. H. Delsemme *In* Ariz. Univ. Comets: Sci. Data and Mission 1 Jul. 1972 p 156-161 (For availability see N73-11833 02-30)
CSCL 03B

Scientific data necessary for a successful flyby or rendezvous cometary mission are outlined. Specific material covers photometric profiles of the different molecular bands of various comets and instruments by which such measurements can be made. E.H.W.

N73-11853* Toledo Univ., Ohio.
PRESENT UNDERSTANDING OF COMETS
A. H. Delsemme *In* Ariz. Univ. Comets: Sci. Data and Mission 1 Jul. 1972 p 174-182 refs (For availability see N73-11833 02-30)
CSCL 03B

An assessment of cometary research from 1970 to 1972 was made. Particular attention was given to the Lyman alpha halo of Comets Tago-Sato-Kosaka, Bennett, and Encke, and the large gas productions of these comets. The icy conglomerate and sand bank models are discussed in detail. E.H.W.

N73-11854* Arizona Univ., Tucson. Lunar and Planetary Lab.
PHOTOGRAPHIC OBSERVATIONS OF COMET BENNETT, 1970II c14
S. M. Larson and R. B. Minton *In its* Comets: Sci. Data and Missions 1 Jul. 1972 p 183-208 refs (For availability see N73-11833 02-30)
(Grant NGL-03-002-002)
CSCL 14E

Direct photography of Comet Bennett with a range of focal lengths shows structure in the coma and strong Type 1 and Type 2 tails. The Type 1 tail shows motion in 15 minutes. The inner coma contains spiral-shaped jets of a type observed visually on occasion in the past but not photographed before. The spiral shape is apparently due to the rotation of the nucleus. On the assumption that the outward velocity of the jets is 0.6 km/sec, as estimated by Delsemme, a rotation period of 1.4 to 1.5 days is derived for the nucleus. The rotation is direct (in the sense of the comet's orbital motion). Author

N73-11855*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMET ENCKE: METEOR METALLIC ION IDENTIFICATION BY MASS SPECTROMETER
R. A. Goldberg and A. C. Aikin Oct. 1972 15 p refs Submitted for publication
(NASA-TM-X-66084; X-625-72-402) Avail: NTIS HC $3.00 CSCL 11F

Metal ions including Na-40(+), Mg-24(+), Si-28(+), K-39(+), Ca-40(+), Sc-45(+), Cr-52(+), Fe-56(+), and Ni-58(+) were detected in the upper atmosphere during the beta Taurids meteor shower. Abundances of these ions relative to Si(+) show agreement in most instances with chondrites. A notable exception is 45(+), which is Sc(+), is 100 times more abundant than neutral scandium found in chondrites. Author

N73-11856*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
CROSS SECTIONS FOR PRODUCTION OF THE CO(A 1 PI)-(X 1 SIGMA) FOURTH POSITIVE BAND SYSTEM AND O(3 S) BY PHOTODISSOCIATION OF CO2
E. P. Gentieu and J. E. Mentall Nov. 1972 40 p refs Submitted for publication
(NASA-TM-X-66088; X-691-72-418) Avail: NTIS HC $4.00 CSCL 03B

The CO(A 1 Pi) cross sections reported here, along with previously determined electron impact results, establish the basis for calculating CO fourth positive system volume emission rates in the Martian dayglow. Calculated volume emission rates in turn determine relative distribution of photon vs. electron impact as mechanisms for producing CO(A 1 Pi) in the Mars atmosphere. The smallness of the O(1304) cross section confirms previous indirect evidence that photodissociative excitation of CO2 is not an important source of O(3 S) in the upper atmosphere of Mars. Author

N73-11857*# Scripta Technica, Inc., Washington, D.C.
QUASI-STATIC OSCILLATIONS IN THE ATMOSPHERE OF eta AQUILAE
P. Ledoux and J. Grandjean NASA Nov. 1972 14 p refs Transl. into ENGLISH from Acad. Roy. Belg., Ser. 5 (Brussels), v. 41, 1955 29 p
(Contract NASw-2036)
(NASA-TT-F-14717) Avail: NTIS HC $3.00 CSCL 03A

The variation with phase of the properties of hydrostatic atmospheric models constructed to interpret the observations of eta Aquilae are discussed from the point of view of the theory of pulsations. The Lagrangian variations of density combined with the equation of continuity (conservation of mass) yield a distribution of velocity with depth which is compatible with the observations. The conservation of energy is satisfied within the precision of the numerical integrations used. In the case of the equation of motion (conservation of momentum), the problem arises of interpreting the small values of the effective gravity q sub e adopted in the models. The hypothesis of very strong convection currents arising in the ionization zone of hydrogen and carrying an appreciable net flux of momentum across the photosphere holds some promise of explaining the weak q sub e, the atmosphere being then composed of large elements nearly in free fall. Author

N73-11858*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ELECTRONS FROM MOLECULAR HYDROGEN IN HI REGIONS
Theodore P. Stecher and David A. Williams Oct. 1972 7 p refs Submitted for publication
(NASA-TM-X-66079; X-672-72-393) Avail: NTIS HC $3.00 CSCL 03B

It is shown that the principal source of electrons in H I regions is the photoionization of vibrationally excited molecular hydrogen by starlight near 1000 A. Author

N73-11859*# National Aeronautics and Space Administration, Washington, D.C.
THE POSSIBILITIES OF THERMAL SOUNDING OF THE ATMOSPHERE OF MARS
Yu. M. Timofeyev, O. M. Pokrovskiy, and T. A. Dvorovik Nov. 1972 14 p refs Transl. into ENGLISH from Kosm. Issled. (Moscow), v. 10, no. 1, 1972 p 92-99
(NASA-TT-F-14715) Avail: NTIS HC $3.00 CSCL 03B

The possibilities of obtaining temperature profiles of the atmosphere of Mars by interpreting the spectral relationship of the outgoing thermal radiation from the planet are reviewed. The mean error in the temperature reconstruction for all temperature profiles investigated is approximately 9 K for measurement errors of 1-2%. All features of temperature profiles, ground and altitude temperature inversions, can be detected. Author

N73-11860*# Singer Co., Binghamton, N.Y. Simulation Products Div.
SHUTTLE VEHICLE AND MISSION SIMULATION REQUIREMENTS REPORT, VOLUME 1
J. F. Burke Oct. 1972 246 p refs 4 Vol.
(Contract NAS9-12836)
(NASA-CR-128621) Avail: NTIS HC $14.50 CSCL 22A

The requirements for the space shuttle vehicle and mission simulation are developed to analyze the systems, mission, operations, and interfaces. The requirements are developed according to the following subject areas: (1) mission envelope, (2) orbit flight dynamics, (3) shuttle vehicle systems, (4) external interfaces, (5) crew procedures, (6) crew station, (7) visual cues, and (8) aural cues. Line drawings and diagrams of the space shuttle are included to explain the various systems and components. Author

N73-11861*# Singer Co., Binghamton, N.Y. Simulation Products Div.
SHUTTLE VEHICLE AND MISSION SIMULATION REQUIREMENTS REPORT, VOLUME 2
J. F. Burke 20 Oct. 1972 338 p refs 4 Vol.
(Contract NAS9-12836)
(NASA-CR-128622) Avail: NTIS HC $19.00 CSCL 22A
For Abstract See N73-11860

N73-11862*# Singer Co., Binghamton, N.Y. Simulation Products Div.
SHUTTLE VEHICLE AND MISSION SIMULATION REQUIREMENTS REPORT, VOLUME 3
J. F. Burke 20 Oct. 1972 557 p refs 4 Vol.
(Contract NAS9-12836)
(NASA-CR-128623) Avail: NTIS HC $30.00 CSCL 22A
For Abstract See N73-11860

N73-11863*# Singer Co., Binghamton, N.Y. Simulation Products Div.
SHUTTLE VEHICLE AND MISSION SIMULATION REQUIREMENTS REPORT, VOLUME 4
J. F. Burke 20 Oct. 1972 291 p refs 4 Vol.
(Contract NAS9-12836)
(NASA-CR-128624) Avail: NTIS HC $16.75 CSCL 22A
For Abstract See N73-11860

N73-11864*# Translation Consultants, Ltd., Arlington, Va.
STUDY OF THE 4 DAY RETROGRADE ROTATION OF THE EXTERNAL CLOUD LAYER OF VENUS
C. Boyer and P. Guerin Washington NASA Oct. 1972 28 p refs Transl. into ENGLISH from Icarus, v. 11, 1969 p 338-355
(Contract NASw-2038)
(NASA-TT-F-14710) Avail: NTIS HC $3.50 CSCL 03B

A brief review is presented of photographic and spectrographic observations which have been used to prove and confirm the retrograde rotation of about 4 days of the external cloud layer of Venus. Certain configurations visible in ultraviolet light - in particular two spots having the shape of a horizontal Y - seem permanent, and their cartography is established. But the observations suggest that high-lying clouds cover these configurations from time to time. An examination of the displacement of the equatorial spots during time intervals of several hours furnishes an instantaneous synodic rotation period somewhat larger than 4 days for the permanent spots. The synodic period is shorter for the variable spots. The observations of the periodic return, at the subsolar point, of the equatorial Y shaped configurations, suggest that the mean rotation period of these spots is remarkably constant and almost equal to 4 days. This period increases considerably when the spot latitudes are greater than + or - 6 deg. Ephemerides have been calculated for the years to come. Author

N73-11865*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INTERSTELLAR MOLECULAR HYDROGEN OBSERVED IN THE ULTRAVIOLET SPECTRUM OF DELTA SCORPII
Andrew M. Smith Oct. 1972 15 p refs Submitted for publication
(NASA-TM-X-66102; X-672-72-419) Avail: NTIS HC $3.00 CSCL 03B

Molecular hydrogen bands of the Lyman and Werner systems were observed in the ultraviolet, interstellar spectrum of delta Sco. The average molecular column density is given, and the average temperature of the gas of which the molecules are part is 47 K. Minimum and maximum gas temperatures are 25 and 98 K respectively. The ratio of the number of hydrogen atoms in molecular form to the total number of hydrogen atoms in either atomic or molecular form is 0.044 (+0.070, -0.018). Author

N73-11866*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COOLING OF DENSE STARS
Sachiko Tsuruta Oct. 1972 27 p refs Presented at IAU Symp. no. 53, Physics of Dense Matter, Boulder, Colo., 21-26 Aug. 1972 Sponsored in part by NAS-NRC
(NASA-TM-X-66101; X-640-72-417) Avail: NTIS HC $3.50 CSCL 03B

Cooling rates were calculated for neutron stars of about one solar mass and 10 km radius, with magnetic fields from zero to about 10 to the 14th power gauss, for extreme cases of maximum and zero superfluidity. The results show that most pulsars are so cold that thermal ionization of surface atoms would be negligible. Nucleon superfluidity and crystallization of heavy nuclei were treated quantitatively, and more realistic hadron star models were chosen. Cooling rates were calculated for a stable hyperon star near the maximum mass limit, a medium weight neutron star, and a light neutron star with neutron-rich heavy nuclei near the minimum mass limit. Results show that cooling rates are a sensitive function of density. The Crab and Vela pulsars are considered, as well as cooling of a massive white dwarf star. Author

N73-11867*# Techtran Corp., Glen Burnie, Md.
SATURN
M. S. Borrov Washington NASA Nov. 1972 16 p ref Transl. into ENGLISH from Zemlya Vselennaya (USSR), Jan. - Feb. 1972 p 10-17
(Contract NASw-2037)
(NASA-TT-F-14617) Avail: NTIS HC $3.00 CSCL 03B

A brief account of research to date on the rings of Saturn is presented. Some of the findings are presented, as regards the composition of the rings, and the author seeks to end the disputes concerning their thickness. Author

N73-11868*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A COMPARISON OF TECHNIQUES FOR INVERSION OF RADIO-RAY PHASE DATA IN PRESENCE OF RAY BENDING
H. Andrew Wallio and Mario D. Grossi (Raytheon Co., Sudbury, Mass.) Washington Nov. 1972 32 p refs
(NASA-TN-D-7098; L-8275) Avail: NTIS HC $3.00 CSCL 03B

Derivations are presented of the straight-line Abel transform and the seismological Herglotz-Wiechert transform (which takes ray bending into account) that are used in the reconstruction of refractivity profiles from radio-wave phase data. Profile inversion utilizing these approaches, performed in computer-simulated experiments, are compared for cases of positive, zero, and negative ray bending. For thin atmospheres and ionospheres, such as the Martian atmosphere and ionosphere, radio wave signals are shown to be inverted accurately with both methods. For dense media, such as the solar corona or the lower Venus atmosphere, the refractive recovered by the seismological Herglotz-Wiechert transform provide a significant improvement compared with the straight-line Abel transform. Author

N73-11869*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A COSMIC X-RAY ASTRONOMY BIBLIOGRAPHY: THE ASTROPHYSICAL JOURNAL, 1962 TO 1972
Robert M. Wilson Apr. 1972 116 p refs
(NASA-TM-X-64705) Avail: NTIS HC $8.00 CSCL 03A

The results are presented of a survey of the Astrophysical Journal for the period January 1962 through March 1972 (volumes 135-172). Some 395 references are contained within this document related to cosmic X-ray astronomy. Author

N73-11870*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE PLANETS URANUS, NEPTUNE, AND PLUTO (1971)
Frank Don Palluconi Nov. 1972 99 p refs
(NASA-SP-8103) Avail: NTIS HC $3.00 CSCL 03B

Design criteria relating to spacecraft intended to investigate the planets of Uranus, Neptune, and Pluto are presented. Assessments were made of the potential effects of environmental properties on vehicle performance. Pertinent data on the mass, radius, shape, mean density, rotational pole location, and mean orbital elements for the three planets are given in graphs and tables. E.H.W.

N73-11871*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
ADVANCED MISSIONS SAFETY. VOLUME 1: EXECUTIVE SUMMARY
15 Oct. 1972 26 p refs
(Contract NASw-2301)
(NASA-CR-129099; ATR-72(7316-01)-1-Vol-1) Avail: NTIS HC $3.50 CSCL 22A

Three separate studies were performed under the general category of advanced missions safety. Each dealt with a separate issue, was a self-contained effort, and was independent of the other two studies. The studies are titled: (1) space shuttle rescue capability, (2) experiment safety, and (3) emergency crew transfer. A separate discussion of each study is presented. Author

N73-11872*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
ADVANCED MISSIONS SAFETY. VOLUME 2: TECHNICAL DISCUSSION. PART 1: SPACE SHUTTLE RESCUE CAPABILITY
E. Perchonok 1 Sep. 1972 113 p refs
(Contract NASw-2301)
(NASA-CR-129104; ATR-72(7316-01)-1-Vol-2-Pt-1) Avail: NTIS HC $7.75 CSCL 22A

A technical discussion of part of the advanced mission safety study is presented. An assessment of the Earth Orbit Shuttle (EOS) capability to perform a rescue mission is developed. Several concepts for augmenting the capability and increasing the EOS rescue mission utility are analyzed. Author

N73-11873*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
ADVANCED MISSIONS SAFETY. VOLUME 2: TECHNICAL DISCUSSION, PART 2: EXPERIMENT SAFETY, GUIDELINES
M. G. Hinton, Jr. 15 Oct. 1972 126 p refs
(Contract NASw-2301)
(NASA-CR-129103; ATR-72(7316-01)-1-Vol-2-Pt-2) Avail: NTIS HC $8.50 CSCL 22A

A technical analysis of a portion of the advanced missions safety study is presented. The potential hazards introduced when experimental equipment is carried aboard the Earth Orbit Shuttle are identified. Safety guidelines and requirements for eliminating or reducing these hazards are recommended. Author

N73-11874*# Goodyear Atomic Corp., Piketon, Ohio. Systems Engineering Operations.
ADVANCED MISSIONS SAFETY. VOLUME 2: TECHNICAL DISCUSSION. PART 3: EMERGENCY CREW TRANSFER
15 Oct. 1972 97 p refs
(Contract NASw-2301)
(NASA-CR-129102; ATR-72(7316-01)-1-Vol-2-Pt-3) Avail: NTIS HC $7.00 CSCL 22A

An evaluation of methods for emergency rescue of space crews using the Earth Orbit Shuttle was conducted. Emergency situations were analyzed for the mission categories of extravehicular activity, space shuttle orbiter, space station, and research applications module (RAM). Five different transfer concept categories were analyzed and each was scored on the basis of its operational effectiveness. A cost analysis of the transfer operations was developed. Author

N73-11875*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
ADVANCED MISSIONS SAFETY. VOLUME 3: APPENDICES. PART 1: SPACE SHUTTLE RESCUE CAPABILITY
15 Oct. 1972 201 p refs
(Contract NASw-2301)
(NASA-CR-129101; ATR-72(7316-01)-1-Vol-3-Pt-1) Avail: NTIS HC $12.25 CSCL 22A

The space shuttle rescue capability is analyzed as a part of the advanced mission safety study. The subjects discussed are: (1) mission evaluation, (2) shuttle configurations and performance, (3) performance of shuttle-launched tug system, (4) multiple pass grazing reentry from lunar orbit, (5) ground launched ascent and rendezvous time, (6) cost estimates, and (7) parallel-burn space shuttle configuration. Author

N73-11876*# Aerospace Corp., El Segundo, Calif. Systems Engineering Operations.
ADVANCED MISSIONS SAFETY. VOLUME 3: APPENDICES. PART 2: EXPERIMENT
M. G. Hinton, Jr. 15 Oct. 1972 270 p refs
(Contract NASw-2301)
(NASA-CR-129100; ATR-72(7316-01)-1-Vol-3-Pt-2) Avail: NTIS HC $15.50 CSCL 22A

Supporting documentation pertaining to the hazards of transporting experimental equipment on the Earth Orbit Shuttle is presented. The subjects discussed are: (1) experiment and hardware definition, (2) hazard analysis, (3) preventive measure assessment, (4) preventive measures statements, (5) remedial measure assessment, and (6) experiment interaction safety considerations. Author

N73-11877# European Space Research and Technology Center, Noordwijk (Netherlands).
TENSOR ANALYSIS, GENERAL RELATIVITY AND GRAVITATIONAL THEORIES
Paris ESRO Aug. 1972 39 p
(ESRO-SN-118-ESTEC) Avail: NTIS HC $4.00

Documents are presented concerning tensor analysis and general relativity, as well as the experimental evidence on which gravitational theories are based. For individual titles, see N73-11878 through N73-11879.

N73-11878 European Space Research and Technology Center, Noordwijk (Netherlands).
TENSOR ANALYSIS AND GENERAL RELATIVITY
F. A. Brunacci *In its* Tensor Analysis, Gen. Relativity and Gravitational Theory Aug. 1971 p 1-16 refs (For availability see N73-11877 02-30)

The fundamentals of tensor analysis in general coordinates are reviewed, including derivatives and Riemann's tensor. Some interesting nonnumerical procedures are mentioned, and applications of tensor analysis to special and general relativity are presented. The fundamentals of this theory are recalled, including Schwarzschild's solution in harmonic coordinates for a central, spherically symmetric field and Robertson's metric.
Author (ESRO)

N73-11879 European Space Research Inst., Frascati (Italy).
PRECISION MEASUREMENTS OF THE GRAVITATIONAL FIELD OF THE SUN
B. Bertotti *In* ESRTC Tensor Analysis, Gen. Relativity and Gravitational Theory Aug. 1972 p 19-30 refs (For availability see N73-11877 02-30)

The present situation of the experimental test of the Schwarzschild line element is outlined. The physical principles and the main difficulties encountered in designing possible space experiments are briefly discussed and special attention is given to the proposed ESRO missions (drag-free probe and twin probes). Author (ESRO)

N73-11880# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
THE COMET-METEOR STREAM COMPLEX
D. A. Mendis (Calif. Univ., San Diego) Aug. 1972 26 p refs Submitted for publication
(Contract NAS8-17929; Grant SWEDSRC-0258-023)
(TRITA-EPP-72-18) Avail: NTIS HC $3.50

The genetic relationship between comets and meteor streams is discussed. It is shown that this relationship may well be a reciprocal one. The formation and dispersion processes in meteor

streams are considered, as well as the question of the accretion and retention of volatiles in the grains. Author (ESRO)

N73-11881# Manchester Univ. (England). Dept. of Astronomy.
SCALED PHOTOGRAMMETRIC RESEARCH Final Scientific Report, 16 Jul. 1967 - 15 Sep. 1971
Zdenek Kopal and Michael Moutsoulas Mar. 1972 84 p refs
(Contract F61052-68-C-0002; AF Proj. 8654)
(AD-744867; AFCRL-72-0310; Rept-0002-3) Avail: NTIS CSCL 03/2

After a critical discussion of the methods of lunar measure which have been developed in the past, an account of the new approach to the problem which was initiated by the Astronomy Department of the University of Manchester with the introduction of star-calibrated lunar photography is given. A description of the computer programs which have been developed for the preparation of the observations and evaluation of the plates is also included. An analysis is presented of the geometrical and dynamical principles on which the various selenographic systems of reference are based, and relations connecting them are found. Author (GRA)

N73-11882# Aerospace Corp., El Segundo, Calif. Lab. Operations.
THE AEROSPACE CORPORATION SPACE SCIENCE PROGRAM REPORT TO COSPAR, JANUARY - DECEMBER 1971
George A. Paulikas, comp. 31 Dec. 1971 20 p refs
(Contract F04701-71-C-0172)
(AD-746326; TR-0172(2260-01)-2; SAMSO-TR-72-169) Avail: NTIS CSCL 04/1

Results obtained during 1971 by the Space Research Program of The Aerospace Corporation are presented. The results deal with magnetospheric physics and the physics of the upper atmosphere. Author (GRA)

N73-11883# Naval Weapons Lab., Dahlgren, Va.
THE POSITION OF A SATELLITE WITH RESPECT TO THE MAGNETOSPHERE OF THE EARTH
Marshall B. Faintich Jun. 1972 20 p refs
(AD-746469; NWL-TR-2760) Avail: NTIS CSCL 22/3

The magnetosphere is approximated by a paraboloid that rotates as it revolves such that its axis is always along the sun-earth line. This paraboloid is determined using a weighted least squares method. The distance from the earth to the outer boundary of the magnetosphere is given in terms of the ecliptic longitude of the sun and the ecliptic longitude and latitude of the direction of sight. In addition, a satellite entrance/exit predictor into/out of the magnetosphere is provided given orbital elements of the satellite. Author (GRA)

N73-11884# Aeronautical Chart and Information Center, St. Louis, Mo. Technical Translation Section.
THE ACTIVITY OF THE ASTRONOMIC COUNCIL DISCUSSED
Jun. 1972 17 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), v. 57, no. 8, 1970 p 3-9
(AD-746016; ACIC-TC-1841) Avail: NTIS CSCL 03/2

The commissions of the Astronomic Council plan coordinate investigations in various fields of astronomy, exercise control over the distribution of the observation time with large telescopes, and engage in the training of specialists. This paper is a discussion of activities undertaken by the commissions. Author (GRA)

N73-11885# Texas Univ., Austin. Dept. of Aerospace Engineering and Engineering Mechanics.
ORBITAL MECHANICS WITH APPLICATIONS TO AEROSPACE AND BALLISTIC SYSTEMS Final Scientific Report, 1 Feb. 1969 - 21 Jan. 1972
Victor Szebehely 1 Jun. 1972 6 p
(Grant AF-AFOSR-1744-69; AF Proj. 97)
(AD-746706; AFOSR-72-1352TR) Avail: NTIS CSCL 12/1

The research results obtained are in the general areas of the solution of large systems of differential equations, the regularization of systems of differential equations applicable to mathematical physics, the theory of stable orbits, the motion of rigid bodies, the motion of the earth, the solution of two-point boundary value problems, the study of optimum aerodynamic shapes, and the numerical solution of the two-point boundary value problem associated with optimal reentry trajectory. Author (GRA)

N73-11591* Florida State Univ., Tallahassee.
LIMB RADIANCE INVERSION: ITERATIVE CONVERGENCE FOR A NONLINEAR KERNAL
John C. Gille *In* NASA. Ames Res. Center Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
CSCL 03A

N73-11598* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PROFILE INVERSION IN PRESENCE OF RAY BENDING
H. Andrew Wallio and Mario D. Grossi (Raytheon Co., Sudbury, Mass.) *In its* Math. of Profile Inversion Aug. 1972 17 p (For availability see N73-11585 02-19)
(Contracts NAS1-9700; NASw-1772)
CSCL 03B

N73-11599* National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York.
ERROR ANALYSIS IN THE MARINER 6 AND 7 OCCULTATION EXPERIMENTS
Richard W. Stewart and Joseph S. Hogan *In its* Math. of Profile Inversion Aug. 1972 10 p (For availability see N73-11585 02-19)
CSCL 03B

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also; 28 Propulsion Systems; and 32 Structural Mechanics.

N73-11886*# Aerospace Corp., El Segundo, Calif. Mass Properties Section.
AEROSPACE VEHICLE SYNTHESIS PROGRAM
Sep. 1972 40 p ref
(Contract NASw-2301)
(NASA-CR-129135; ATR-73(7313-01)-5) Avail: NTIS HC $4.00 CSCL 22B

A modified version of the Aerospace Vehicle Synthesis Program (VSP) to simulate a space shuttle on the computer is presented. The effects of various changes such as payload weight, and orbital velocity can be determined along with minimum costs in vehicle design. The program logic, and weight estimating equations are discussed, and an example case of a solid propellant boosted, drop tank orbiter is included to indicate the type of results produced by the VSP. F.O.S.

N73-11887*# Aerospace Corp., El Segundo, Calif. Advanced Vehicle Systems Directorate.
ANALYSIS OF SPACE TUG OPERATING TECHNIQUES SUPPLEMENTAL REPORT (STUDY 2.4)
Oct. 1972 49 p refs
(Contract NASw-2301)
(NASA-CR-129163; ATR-73(7314)-2) Avail: NTIS HC $4.50 CSCL 22B

An analysis of space tug operating techniques is presented. The subjects discussed are: (1) sustaining engineering requirements, (2) off-site facility requirements, (3) evaluation of tug checkout alternatives, and (4) spares provisioning. Tables of data are included to clarify the written presentation. Author

N73-11888*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ATMOSPHERE EXPLORER CONTROL SYSTEM SOFTWARE (VERSION 1.0)
Anthony Villasenor Oct. 1972 78 p refs
(NASA-TM-X-66086; X-324-72-413) Avail: NTIS CSCL 22B

The basic design is described of the Atmosphere Explorer Control System (AECS) software used in the testing, integration,

and flight contol of the AE spacecraft and experiments. The software performs several vital functions, such as issuing commands to the spacecraft and experiments, receiving and processing telemetry data, and allowing for extensive data processing by experiment analysis programs. The major processing sections are: executive control section, telemetry decommutation section, command generation section, and utility section.

F.O.S.

N73-11889*# McDonnell-Douglas Co., Huntington Beach, Calif.
EVALUATION OF METAL LANDING GEAR DOOR ASSEMBLY SELECTIVELY REINFORCED WITH FILAMENTARY COMPOSITE FOR SPACE SHUTTLE APPLICATION Final Report, May 1971 - Jun. 1972
S. J. Kong and V. L. Freeman Nov. 1972 93 p refs
(Contract NAS1-10785)
(NASA-CR-112172) Avail: NTIS HC $6.75 CSCL 22B

The development and evaluation of a main landing gear door for space shuttle applications are discussed. The door is constructed of composite materials using a rib-stiffened titanium panel selectively reinforced with boron/epoxy composite. A weight comparison between the hybrid design and the all-titanium baseline design showed a weight saving of approximately fifteen percent. Detailed descriptions of the door structure and method of manufacture are presented. Author

N73-11890*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
LEE-SURFACE HEATING AND FLOW PHENOMENA ON SPACE SHUTTLE ORBITERS AT LARGE ANGLES OF ATTACK AND HYPERSONIC SPEEDS
Jerry N. Hefner Washington Nov. 1972 43 p refs
(NASA-TN-D-7088; L-8580) Avail: NTIS HC $4.25 CSCL 22B

The lee-surface flow phenomena on a delta-wing orbiter and a straight-wing orbiter have been investigated at angles of attack between 0 deg and 50 deg at a Mach number of 6. Limited studies of the delta-wing orbiter were conducted at a Mach number of 19. Heat-transfer data, pressure distributions, and oil-flow studies were employed to experimentally examine the nature of the surface flow and the severity of the lee-surface heating. The effects of Reynolds number on the flow field and heating were investigated. Problem areas are defined and areas for further study are recommended. Author

N73-11891*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
WIND-TUNNEL TESTS OF A SINGLE STAGE TO ORBIT SPACE SHUTTLE AT MACH NUMBERS OF 2.60, 3.85, AND 4.64
Ernald B. Graves Washington Nov. 1972 29 p
(NASA-TM-X-2667; L-8480) Avail: NTIS HC $3.00 CSCL 22B

Wind tunnel tests were conducted to determine the static aerodynamic characteristics of a single-stage-to-orbit space shuttle model at Mach numbers of 2.60, 3.85, and 4.64. Test parameters included various payloads for the launch configurations and various corner radii for the entry configurations. The test results for the launch configurations generally indicated that a decrease in payload size resulted in a marked increase in axial force. Decreasing the corner radii of the entry configuration led to large increases in axial force. The results also indicated that the presence of an engine door on the entry configuration caused a measurable positive increment in pitching moment. Changing the entry configuration afterbody geometry from a biconic shape to a conic shape increased the normal-force and stability level.

Author

N73-11892*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ACCELERATED LIFE TESTING OF SPACECRAFT SUBSYSTEMS
D. Wiksten and J. Swanson 1 Nov. 1972 46 p refs
(Contract NAS7-100)
(NASA-CR-129096; JPL-TM-33-575) Avail: NTIS HC $4.50 CSCL 22B

The rationale and requirements for conducting accelerated life tests on electronic subsystems of spacecraft are presented. A method for applying data on the reliability and temperature sensitivity of the parts contained in a subsystem to the selection of accelerated life test parameters is described. Additional considerations affecting the formulation of test requirements are identified, and practical limitations of accelerated aging are described. Author

N73-11893*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
ADVANCED ETC/LSS COMPUTERIZED ANALYTICAL MODELS, CO2 CONCENTRATION. VOLUME 1: SUMMARY DOCUMENT Final Report
B. N. Taylor and A. V. Loscutoff 13 Oct. 1972 97 p refs 2 Vol.
(Contract NAS9-12076)
(NASA-CR-128630; MDC-G3799-Vol-1) Avail: NTIS HC $7.00 CSCL 22B

Computer simulations have been prepared for the concepts of CO2 concentration which have the potential for maintaining a CO2 partial pressure of 3.0 mmHg, or less, in a spacecraft environment. The simulations were performed using the G-189A Generalized Environmental Control computer program. In preparing the simulations, new subroutines to model the principal functional components for each concept were prepared and integrated into the existing program. Sample problems were run to demonstrate the methods of simulation and performance characteristics of the individual concepts. Comparison runs for each concept can be made for parametric values of cabin pressure, crew size, cabin air dry and wet bulb temperatures, and mission duration. Author

N73-11894*# McDonnell-Douglas Astronautics Co., Huntington Beach, Calif.
ADVANCED ETC/LSS COMPUTERIZED ANALYTICAL MODELS, CO2 CONCENTRATION. VOLUME 2: SIMULATION MANUAL Final Report
B. N. Taylor and A. V. Loscutoff 13 Oct. 1972 238 p refs 2 Vol.
(Contract NAS9-12076)
(NASA-CR-128631; MDC-G3799-Vol-2) Avail: NTIS HC $14.00 CSCL 22B

For Abstract See N73-11893

N73-11895*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: LONGITUDINAL AERODYNAMIC CHARACTERISTICS OF LOW ASPECT RATIO WING CONFIGURATIONS IN GROUND EFFECT FOR A MOVING AND STATIONARY GROUND SURFACE
P. O. Romere and E. B. Chambliss Nov. 1972 101 p refs
(Contract NAS8-4016)
(NASA-CR-120082; DMS-DR-2004) Avail: NTIS HC $7.25 CSCL 22B

A 0.05-scale model of the NASA-MSC Orbiter 040A Configuration was tested. Test duration was approximately 80 hours during which the model was tested in and out of ground effect with a stationary and moving ground belt. Model height from ground plane surface was varied from one and one-half wing span to landing touchdown while angle of attack varied from -4 to 20 degrees. Eleven effectiveness and alternate configuration geometries were tested to insure complete analysis of low aspect ratio wing aircraft in the presence of ground effect. Test Mach number was approximately 0.067 with a corresponding dynamic pressure value of 6.5 psf. Author

N73-11896*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: STABILITY AND CONTROL EFFECTIVENESS AT HIGH AND LOW ANGLES OF ATTACK AND EFFECTS OF VARIATIONS IN ENGINE SHROUND, FIN, AND DRAG PETAL CONFIGURATIONS FOR THE BOEING 0.008899-SCALE PRESSURE-FED BALLISTIC RECOVERABLE BOOSTER, MODEL 979-160
R. L. Hanson, R. G. OBrien, M. Y. Oiye, and S. Vanderleest Oct. 1972 665 p
(Contract NAS8-4016)
(NASA-CR-120073; DMS-DR-1275) Avail: NTIS HC $35.25 CSCL 22B

Experimental aerodynamic investigations were carried out in the Boeing transonic and supersonic wind tunnels on a 0.008899-scale model of a proposed pressure-fed ballistic recoverable

booster (BRB) configuration. The purpose of the test program was to determine the stability and control effectiveness of the basic configuration at high and low angles of attack, and to conduct parametric studies of various engine shroud, fin, and drag petal configurations. Six-component force data and base pressure data were obtained over a Mach number range of 0.35 to 4.0 at angles of attack of -5 to 25 and 55 to 85 at zero degrees sideslip and over a sideslip range of -10 to +10 at angles of attack ranging from -10 to 72.5. Two-component force data were also obtained with a fin balance on selected runs. Author

N73-11897*# National Aeronautics and Space Administration, Washington, D.C.
COMBINING ASCENT LOADS
J. C. Houbolt May 1972 36 p refs
(NASA-SP-8099) Avail: NTIS HC $3.00 CSCL 22B

Criteria and guidelines are presented for combining loads that develop during the ascent phase of a space flight. The primary load-caring structure is discussed including the basic tank and interconnecting members, engine support mounts and connections to tank structure, transition structures between stages, payload shrouds, and the basic support points at separation planes. F.O.S.

N73-11898*# Boeing Co., Seattle, Wash.
THERMAL-STRUCTURAL COMBINED LOADS DESIGN CRITERIA STUDY Final Report, 1 Mar. 1971 - 29 Feb. 1972
V. Deriugin, E. W. Brogren, C. L. Jaeck, A. L. Brown, and B. E. Clingan Washington NASA Oct. 1972 281 p refs
(Contract NAS1-6024)
(NASA-CR-2102; D180-14647-1) Avail: NTIS HC $3.00 CSCL 22B

A study was conducted to determine methodology for combining thermal structural loads and assessing the effects of the combined loads on the design of a thermal protection system and a hot structure of a high cross range delta wing space shuttle orbiter vehicle. The study presents guidelines for establishing a basis for predicting thermal and pressure environments and for determining limit and ultimate design loads on the vehicle during reentry. Limit trajectories were determined by using dispersions on a representative nominal mission and system parameters expected during the life of the vehicle. Nine chosen locations on the vehicle surface having TPS or hot structures were examined, and weight sensitivity analyses were performed for each location. Author

N73-11899*# Fairchild Industries, Inc., Germantown, Md. Space and Electronics Div.
APPLICATIONS TECHNOLOGY SATELLITE ADVANCED MISSIONS STUDY, VOLUME 1 Final Report
D. L. Robinson et al [1972] 206 p
(Contract NAS3-14360)
(NASA-CR-120873-Vol-1) Avail: NTIS HC $12.50 CSCL 22B

Four different spacecraft configurations were developed for geostationary service as a high power communications satellite. The first configuration is a Thor-Delta launch into a low orbit with a spiral ascent to synchronous altitude by ion engine propulsion. The spacecraft is earth oriented with rotating solar arrays. Configuration 2 is a direct injection Atlas/Centaur/Burner II vehicle which when in orbit is sun-oriented with a rotating transponder tower. Configurations 3 and 4 are Titan IIIC launches, and are therefore larger and heavier than Configuration 2. They are both sun-oriented, with rotating transponder towers and are directly injected into orbit. Technology discussed includes high power (up to 2 kW) transmitters with collectors radiating heat directly into space, and contoured antenna patterns designed to illuminate particular earth regions. There is also a review of potential users of the services which can be performed by this type satellite in such areas as information networking, public broadcasting and educational television. Author

N73-11900*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SYNCHRONOUS METEOROLOGICAL SATELLITE SYSTEM DESCRIPTION DOCUMENT, VOLUME 3
F. B. Pipkin Dec. 1971 345 p refs
(NASA-TM-X-68839) Avail: NTIS HC $19.25 CSCL 22B

The structural design, analysis, and mechanical integration of the synchronous meteorological satellite system are presented. The subjects discussed are: (1) spacecraft configuration, (2) structural design, (3) static load tests, (4) fixed base sinusoidal vibration survey, (5) flight configuration sinusoidal vibration tests, (6) spacecraft acoustic test, and (7) separation and shock test. Descriptions of the auxiliary propulsion subsystem, the apogee boost motor, communications system, and thermal control subsystem are included. Author

N73-11901*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: AERODYNAMIC CHARACTERISTICS OF VARIOUS MDAC SPACE SHUTTLE ASCENT CONFIGURATIONS WITH PARALLEL BURN PRESSURE-FED AND SRM BOOSTERS. VOLUME 1: TANKS T1 AND T2 ASCENT CONFIGURATIONS
T. W. Jarrett Oct. 1972 1082 p
(Contract NAS8-4016)
(NASA-CR-120083; DMS-DR-1230) Avail: NTIS HC $56.25 CSCL 22B

Various space shuttle ascent configurations were tested in a trisonic wind tunnel to determine the aerodynamic characteristics. The ascent configuration consisted of a NASA/MSC 040 orbiter in combination with various HO centerline tank and booster geometries. The aerodynamic interference between components of the space shuttle and the effect on the orbiter aerodynamics was determined. The various aerodynamic configurations tested were: (1) centerline HO tanks T1 and T2, (2) centerline HO tank T3, and (3) centerline HO tank H4. Author

N73-11902*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: AERODYNAMIC CHARACTERISTICS OF VARIOUS MDAC SPACE SHUTTLE ASCENT CONFIGURATIONS WITH PARALLEL BURN PRESSURE-FED AND SRM BOOSTERS. VOLUME 2: TANK T3 CONFIGURATIONS
T. W. Jarrett Oct. 1972 713 p refs 5 Vol.
(Contract NAS8-4016)
(NASA-CR-120084; DMS-DR-1230-Vol-2) Avail: NTIS HC $37.75 CSCL 22B
For Abstract see N73-11901

N73-11903*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: AERODYNAMIC CHARACTERISTICS OF VARIOUS MDAC SPACE SHUTTLE ASCENT CONFIGURATIONS WITH PARALLEL BURN PRESSURE-FED AND SRM BOOSTERS. VOLUME 3: TANK T4 CONFIGURATIONS
T. W. Jarrett Oct. 1972 693 p refs 5 Vol.
(Contract NAS8-4016)
(NASA-CR-120085; DMS-DR-1230-Vol-3) Avail: NTIS HC $36.75 CSCL 22B
For Abstract see N73-11901

N73-11904*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: AERODYNAMIC CHARACTERISTICS OF VARIOUS MDAC SPACE SHUTTLE ASCENT CONFIGURATIONS WITH PARALLEL BURN PRESSURE-FED AND SRM BOOSTERS. VOLUME 4: ASCENT CONFIGURATION PLUME STUDIES AND MODEL BUILDUP
T. W. Jarrett Oct. 1972 550 p 5 Vol.
(Contract NAS8-4016)
(NASA-CR-120086; DMS-DR-1230) Avail: NTIS HC $29.50 CSCL 22B
For Abstract see N73-11901

N73-11905*# Chrysler Corp., New Orleans, La. Space Div.
SPACE SHUTTLE: AERODYNAMIC CHARACTERISTICS OF VARIOUS MDAC SPACE SHUTTLE ASCENT CONFIGURATIONS WITH PARALLEL BURN PRESSURE-FED AND SRM BOOSTERS. VOLUME 5: ORBITER, TANKS AND BOOSTER ALONE CONFIGURATIONS
T. W. Jarrett Oct. 1972 648 p refs 5 Vol.
(Contract NAS8-4016)
(NASA-CR-120087; DMS-DR-1230-Vol-5) Avail: NTIS HC $34.50 CSCL 22B
For Abstract see N73-11901

N73-11906# European Space Research and Technology Center, Noordwijk (Netherlands).
THE ESRO 4 PROJECT. DESCRIPTION OF THE SCIENTIFIC EXPERIMENTS
R. Jaeschke, (comp.) and J. Tunaley, (comp.) Paris ESRO May 1972 46 p
(ESRO-SN-114-ESTEC) Avail: NTIS HC $4.50

The aim of the ESRO-4 mission is to investigate neutral particle and ion concentrations in the ionosphere and near magnetosphere, to detect auroral particles and to monitor solar particles. Of the five scientific experiments carried by the satellite, three measure energetic particles, one is a neutral gas mass spectrometer, and the fifth used Langmuir probes to investigate the ion and electron density and temperature distributions. The aims, main features and operating characteristics of each of the experiments are outlined. Author (ESRO)

N73-11907# Engins Matra, Velizy (France).
CONTROL OF A COMPENSATED DRAG PROBE. PROJECT SOREL, VOLUME 3 [CONTROLE D'UNE SONDE A TRAINEE COMPENSEE. PROJET SOREL RAPPORT FINAL]
J. Broquet 26 Jun. 1972 88 p In FRENCH 3 Vol.
(Contract ESTEC-1492/71-EL)
(S-3-1949-Vol-3; ESRO-CR(P)-124-Vol-3) Avail: NTIS HC $6.50

The simulation control of the SOREL space probe attitude and position is discussed. It includes an analysis of the functioning of position and attitude channels in interaction absence, with emphasis on the influence of inertia ratio (lambda) on the behavior of the attitude guidances system. The convergence rapidity of the attitude control system in the laser search mode is analyzed. The coupling effects between the guidance systems due to nozzle misalignments, to misalignments of the satellite geometrical axis on the greater inertia axis, and to uneven thrust conditions of the attitude nozzles, are also discussed. Author (ESRO)

N73-11908# Louvain Univ. (Belgium).
ATTITUDE STABILITY OF DUAL-SPIN SATELLITES
Pierre Y. Willems Paris ESRO Jun. 1972 145 p refs
(Contract ESTEC-943/70)
(ESRO-CR-56) Avail: NTIS HC $9.25

The motion and stability of non-idealized dual-spin satellites are considered. The satellite equations of motion are initially derived for a very general case, then simplified for the study of particular problems. A hybrid approach is employed, in which the Euler equations are used for the overall system and the Lagrange equations are used for the deformation variables. This leads to a set of equations which are well-suited to stability analysis. The mathematical model includes the nutation damper, the fuel slosh and system asymmetry and misalignments. The stability of a system with two symmetric, undeformable bodies connected by a flexible bearing is analyzed using Lyapunov's method, and some criteria are obtained. Cases in which both sections are deformable, for example, having fuel slosh in the rotor and a nutation damper on the platform, are analyzed analytically by an approximate asymptotic expansion method and numerically by the Floquet technique. The results confirm the heuristic energy-sink results. The behavior of the dual-spin system during spin-up operations was also studied and simulated. Further confirmation of the validity and viability of the dual-spin stabilization concept is provided. Author (ESRO)

N73-11909# European Space Research and Technology Center, Noordwijk (Netherlands).
DESIGN OF MANOEUVRING MODES FOR THE ESRO 4 SATELLITE
P. J. Berlin and L. M. Palenzona May 1972 54 p refs
(ESRO-TN-108-ESTEC) Avail: NTIS HC $4.75

A review is given of the fundamentals of the gyroscopic effect and the geomagnetic field. The principles of magnetic attitude control of satellites, the theory behind the quarter-orbit magnetorquer polarity switching technique, and its implementation in the ESRO-4 mission are described. Various maneuvering schemes and their merits are discussed. The implementation of attitude control by magnetorquer in the ESRO-4 mission is illustrated by maneuver planning procedures and computer simulations. Author (ESRO)

N73-11910# Royal Aircraft Establishment, Farnborough (England).
ANALYSIS OF THE ORBIT OF COSMOS 316 (1969-108A)
D. G. King-Hele Apr. 1972 50 p refs
(RAE-TR-72062; Space-391; BR-29127) Avail: NTIS HC $4.50

The Cosmos 316 orbits have been determined at 36 epochs of the satellite life using the PROP program and 1600 observations, mainly radar and visual. The changes in inclination are analyzed to determine the upper atmosphere winds which prove to be very variable. The most extreme is a west-to-east wind of order 300 m/s in the afternoon in near-equatorial regions of the Southern Hemisphere between 24 July and 7 August, 1970. The perigee distances used previously in determining variations of upper-atmosphere density, are now also used to evaluate scale height. It proved possible to detect the change in inclination at the time of 15th-order resonance with the earth's gravitational field, when successive ground tracks are 24 deg apart, and an equation for the 15th-order coefficients in the geopotential was obtained which confirms recent results from Transit 1B.
Author (ESRO)

N73-11911# Aerospace Corp., El Segundo, Calif.
A TWIN-WHEEL MOMENTUM BIAS/REACTION JET SPACECRAFT CONTROL SYSTEM Technical Report, Jul. 1970 - Feb. 1972
Phil R. Dahl 1 Jun. 1972 18 p refs
(Contract F04701-71-C-0172)
(AD-745961; SAMSO-TR-72-170; TR-0172(2441-02)-1) Avail: NTIS CSCL 22/2

A spacecraft control system is presented that uses two identical speed-biased and speed-modulated reaction wheels with resultant momentum nominally oriented along the orbit normal. The wheels are in a vee configuration and the system is devised so that along with gas reaction jets, a horizon sensor, and electronics, it provides closed-loop continuous control about the pitch and roll axes with active nutation damping. Equations of motion, control system block diagrams, and dynamics and stability analyses are presented. The application of the system to a typical spacecraft indicates ease of design, good response, and simple, state-of-the-art implementation. Author (GRA)

N73-11912# White Sands Missile Range, N.Mex.
STATE SPACE TECHNIQUES FOR INERTIAL MEASUREMENT UNIT VARIABLES FOR RANGE TESTS
James S. Pappas and Robert D. Orlov Apr. 1972 141 p refs
(AD-746657; WSMR-TR-34) Avail: NTIS CSCL 22/3

State space techniques for obtaining math models of flight test vehicles with nonlinear measurement variables in many different moving bases are presented. Inertial measurement units (IMU) on-board variables are related to the state variables of interest for obtaining a Best Estimate of Trajectory (BET).
Author (GRA)

N73-11913# Gulf Radiation Technology, San Diego, Calif.
CONFIDENCE IN SURVIVABILITY
V. A. J. VanLint 16 Aug. 1971 14 p
(Contract F04701-70-C-0096; AF Proj. 6141)
(AD-746061; GULF-RT-A10799; SAMSO-TR-72-197) Avail: NTIS CSCL 16/1

The survivability of a military system depends on its design, construction, the threat posed to it by an enemy, and the tactics under which we employ the system. The problem of evaluating survivability with confidence is usually simplified by specifying the hardness required, i.e., the environments the system must withstand without serious degradation, avoiding the time evolving issues of threat and tactics. If the hardness requirements have been chosen wisely, they allow for an acceptable range of tactics on our part to compensate for credible ranges of evolving threats during the effective life of the system. Author (GRA)

N73-11914# Lowell Technological Inst. Research Foundation, Mass.
DESIGN AND FABRICATION OF SOUNDING ROCKET PAYLOADS Final Report, 1 Jan. 1970 - 31 May 1972
Richard E. Kenyon May 1972 59 p
(Contract F19628-70-C-0149; AF Proj. 8692)
(AD-745977; LTIRF-345/SE; AFCRL-72-0314) Avail: NTIS

CSCL 19/7
The report reviews work accomplished from February 1970 through May 1972 on the design, integration and launch support of high altitude sounding rocket payloads. Each payload undertaken or completed is described in a brief synopsis stating: the basic experimental objectives; support electronics and instrumentation supplies; and launch support results. Other material presented includes: monitor circuit techniques; description of NiCad battery charger; results of tests on NiCad batteries; discussions of: a squib checker; a door eject mechanism; a payload separation mechanism; and a despin mechanism. Author (GRA)

N73-11915*# Fairchild Industries, Inc., Germantown, Md. Space and Electronics Div.
APPLICATIONS TECHNOLOGY SATELLITE ADVANCED MISSIONS STUDY, VOLUME 2 Final Report
D. L. Robinson et al [1972] 293 p
(Contract NAS3-14360)
(NASA-CR-120873-Vol-2) Avail: NTIS HC $16.75 CSCL 22B
For Abstract see N73-11899

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N73-11916 National Lending Library for Science and Technology, Boston Spa (England).
THE DERIVATION OF DEFLECTION INFLUENCE SURFACES OF THE SKEW PLATES
M. Suchar Sep. 1972 25 p refs Transl. into ENGLISH from Rozprany Inzynierskie (Poland), v. 7 no. 2, (125), 1959 p 237-259 (NLL-RTS-7401) Avail: Natl. Lending Library, Boston Spa, Engl.: £2.50 or 8 NLL photocopy coupons

The numerical analysis of thin skew plates or panels used in bridge and airframe type structures is discussed. The applications of rectangular coordinate systems and skew coordinate systems are described. The application of matrix-tensor techniques to derive the fundamental equations of an elastic isotropic body in terms of skew coordinates is presented. Mathematical models are included to clarify the presentation. Author

N73-11917 National Lending Library for Science and Technology, Boston Spa (England).
APPLICATION OF THE METHOD OF DYNAMIC STIFFNESS TO CALCULATIONS ON THE COMBINED VIBRATIONS OF THE BLADES OF AXIAL TURBOMACHINERY
M. L. Kempner Aug. 1972 19 p refs Transl. into ENGLISH from Tr. Mosk. Inst. Inzh. Zheleznodorozhnogo Transp. (Moscow), no. 260, 1968 p 67-81
(NLL-RTS-7305) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.90; 6 NLL photocopy coupons

Banding systems to prevent fracture of turbine blades resulting from vibration are discussed. The application of a method of dynamic stiffness to calculate the combined vibrations of the blades of axial turbomachinery is described. Mathematical models are included to show the determination of natural vibrations in ring coupling systems and vibrations of blades with an inextensible shroud. Author

N73-11918 National Lending Library for Science and Technology, Boston Spa (England).
METHOD OF CLASSIFYING STRESSES ACCORDING TO THE OPTICAL METHOD
V. K. Vorontsov and L. A. Ulanova [1972] 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb Zaved., Chern. Met. (Moscow), no. 5, 1972 p 67-69 In RUSSIAN and ENGLISH
(NLL-M-21475-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A method for classifying stresses according to the optical method data is presented. The analysis of an isotropic work-hardening media using the polarized light method is described. A relationship is deduced for determining the tensor components of the stresses. The experimental sequence and mathematical operations during treatment of experimental data for determining the tensor components of the stresses are included. Author

N73-11919 Engineering Sciences Data Unit, London (England).
BENDING MOMENT AT ENDS OF A STRUT DUE TO INITIAL CURVATURE
Feb. 1970 3 p Sponsored by Roy. Aeron. Soc.
(ESDU-01.01.14) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

A solution to the bending moment of an initially curved strut subjected to end loads and end restraining moments is graphed. The flexural stiffness of the strut was assumed to be uniform along the strut length and constant during the process of deflection. E.H.W.

N73-11920 Engineering Sciences Data Unit, London (England).
BENDING MOMENT AT ENDS OF A STRUT DUE TO END LOADS AND END MOMENTS
Mar. 1969 3 p Sponsored by Roy. Aeron. Soc.
(ESDU-01.01.15) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The bending moment of an initially straight strut subjected to end loads and end moments is determined. Flexural stiffness of the strut was assumed to be uniform along the strut length and constant during the process of deflection. The solution is graphed. E.H.W.

N73-11921 Engineering Sciences Data Unit, London (England).
THE BUCKLING OF A COMPOSITE STRUT
Mar. 1969 4 p ref Sponsored by Roy. Aeron. Soc.
(ESDU-01.01.23) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The two parts of the strut are each of constant flexural rigidity and rigidly attached end to end. The centroids of all sections lie on the axis of loading. The axes of minimum inertia of the two parts are coplanar. Combinations of curves may be used for symmetrical three bay composite struts. Author

N73-11922 Engineering Sciences Data Unit, London (England).
THE COMPRESSIVE INSTABILITY OF HYDRAULIC JACKS
Jun. 1966 4 p Sponsored by Roy. Aeron. Soc.
(ESDU-01.01.24) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The charts were derived from a theory using the concept of overlapping stiffness. It is assumed that the cylinder and piston rod have uniform section and material properties over their entire lengths and that their section centroids are initially perfectly aligned. It is assumed that the piston rod is simply supported at the piston and the gland. The jack assembly is pin-jointed at both ends. Author

N73-11923 Engineering Sciences Data Unit, London (England).
BENDING MOMENTS AT THE ENDS OF A STRUT DUE TO END LOAD AND TRIANGULARLY DISTRIBUTED SIDE LOAD
Jan. 1967 8 p Sponsored by Roy. Aeron. Soc.
(ESDU-01.01.25) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Curves are presented for determining the bending moments of struts under the combined action of end loads, and a triangularly distrubuted side load. Examples of the application of the curves are included. F.O.S.

N73-11924 Engineering Sciences Data Unit, London (England).
THE FATIGUE LIMIT OF UNNOTCHED STEEL SPECIMENS: IN BENDING AND UNDER AXIAL LOADING
Apr. 1965 9 p refs Sponsored by Roy. Aeron. Soc.
(ESDU-E.07.04) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The results of about 260 series of fatigue tests on unnotched

steel specimens were analyzed to give curves of S sub f zero against f sub t and (S sub f)/(S sub f zero) against (S sub m)/(f sub t). The composition of the steels ranged from low carbon to Ni-Cr-Mo, a large proportion being of the latter composition. A few results from austenitic stainless steels are also included. All specimens were obtained from bar stock or forgings. The surfaces were turned, ground or polished. K.P.D.

N73-11925 Engineering Sciences Data Unit, London (England).
TERMS AND NOTATION FOR FATIGUE ANALYSIS
Nov. 1970 15 p Supercedes ESDU-Fat-G.00.02
(ESDU-70016; ESDU-Fat-G.00.02) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The basic terms, notation, and forms of presentation for fatigue data are defined. The presentation consists of the symbol, term, and units of measurement. The subjects discussed are: (1) sign convention, (2) fatigue under cycles of constant amplitude, (3) fatigue under variable stress levels, and (4) stress concentration. Strain strain diagrams and line drawings are provided to clarify the presentation. Author

N73-11926 Ernst-Mach-Inst., Freiburg (West Germany).
SHOCK TUBE EXPERIMENTS ON PANELS BLOWN OUT FROM BUILDING FRAMES
G. Sliter 1972 35 p refs
(Repts-1/72) Avail: Issuing Activity

The forces transmitted to a building frame were calculated and measured when panels on the outer surface of a building were blown out by shock-tube-produced blast waves. In the experiments, asbestos cement panels attached edgewise to a steel frame were shattered by the shock wave produced in a 2.4 m diameter shock tube. The reaction history at each corner of the steel frame was measured by force gages. The results of several preliminary tests are given. An eigen frequency solution in which the panels are treated as elastic beams partly explains unexpected results of experiments. Plans for further tests and possible improved calculation techniques are also discussed.
Author (ESRO)

N73-11927*# Toronto Univ. (Ontario).
BUCKLING OF CIRCULAR CYLINDRICAL SHELLS UNDER DYNAMICALLY APPLIED AXIAL LOADS
J. D. Tulk Jun. 1972 90 p refs
(Grants NGR-52-026-011; NRC A-2783)
(NASA-CR-129086; UTIAS-160) Avail: NTIS HC $6.50 CSCL 20K

A theoretical and experimental study was made of the buckling characteristics of perfect and imperfect circular cylindrical shells subjected to dynamic axial loading. Experimental data included dynamic buckling loads (124 data points), high speed photographs of buckling mode shapes and observations of the dynamic stability of shells subjected to rapidly applied sub-critical loads. A mathematical model was developed to describe the dynamic behavior of perfect and imperfect shells. This model was based on the Donnell-Von Karman compatibility and equilibrium equations and had a wall deflection function incorporating five separate modes of deflection. Close agreement between theory and experiment was found for both dynamic buckling strength and buckling mode shapes. Author

N73-11928# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
THE ANALYSIS OF THE DYNAMIC RESPONSE OF LINEAR VISCOELASTIC MATERIALS
R. C. Tennyson, D. Zimcik, and J. D. Tulk Jan. 1972 59 p refs
(Grant DRB-G-9501-02)
(UTIAS-159) Avail: NTIS HC $5.00

A combined analytical and experimental program was undertaken to demonstrate a direct method of determining the complex modulus of a linear viscoelastic material as a function of frequency. Fourier analysis of a dynamic strain pulse (produced by the detonation of an explosive charge) propagating down a long circular cylindrical rod was employed to evaluate the effects of attenuation and dispersion. In addition, experiments were performed with the split Hopkinson bar apparatus to provide data on the range of linear behaviour. Results are presented for two materials tested at room temperature (75 F), polymethylmethacrylate (PMMA) and a clear epoxy system (Hysol) cured at room temperature. It was found that the results obtained on PMMA were in agreement with the data presented by other investigators at lower frequency levels. Author

N73-11929# Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
STRESS WAVES IN FINITE LONGITUDINALLY-LAYERED SHELLS
M. Ziv Jun. 1972 62 p refs
(TAE-154) Avail: NTIS HC $5.25

The transient response of a finite longitudinally-layered cylindrical membrane shell impacted by longitudinal axisymmetric loads is obtained. Membrane stress distribution and particle velocities are determined for the entire solution domain. The method of solution consists of characteristics finite difference technique and discontinuity relations. A characteristics finite difference integration scheme is constructed for regions where the variables are continuous. Discontinuities relations are developed to encounter the impulsive leading wave and its reflection and refraction at the interfaces. An example problem which demonstrates the method is solved. Author

N73-11930# Aeronautical Research Labs., Melbourne (Australia).
NUMERICAL EVALUATION OF WHEELER'S MODEL OF FATIGUE CRACK PROPAGATION FOR PROGRAMMED LOAD SPECTRA
R. H. Keays Apr. 1972 36 p refs
(ARL/SM-Note-376) Avail: NTIS HC $4.00

A mathematical model of a fatigue crack propagation effect in which the application of a single high load can significantly reduce the crack propagation rate under subsequent smaller load cycles is presented. A FORTRAN program for the model is described and applied in a theoretical study of crack propagation in ultra high strength steel under two programmed load spectra. The effects of variation of several of the parameters entering into the model are investigated as well as the effects of changes in loading order. Author

N73-11931*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
STRESS, STABILITY, AND VIBRATION OF COMPLEX BRANCHED SHELLS OF REVOLUTION: ANALYSIS AND USER'S MANUAL FOR BOSOR4
David Bushnell Washington NASA Oct. 1972 318 p refs
(Contracts NAS1-10929; N00014-71-C-0002)
(NASA-CR-2116; LMSC-D243605) Avail: NTIS HC $3.00 CSCL 13M

A comprehensive computer program for the stress, stability, and vibration analyses of segmented, ring-stiffened, branched shells of revolution is presented. The program includes nonlinear prestress effects and is very general with respect to geometry of meridian, shell wall design, edge conditions, and loading. Despite its generality, the program is easy to use. Branches are provided such that for commonly occurring cases the input data involves only basic information such as geometrical and material properties. The computer program has been verified by comparisons with other known solutions and test results. The manual consists of several sections in which the program scope is described, the analysis on which it is based is given, the flow of calculations is outlined, the input data are defined with sample cases, various possible pitfalls are emphasized, and sample list and plot output are given and described. Author

N73-11932*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PANEL FLUTTER Space Vehicle Design Criteria (Structures)
E. H. Dowell Jun. 1972 52 p refs Revised
(NASA-SP-8004) Avail: NTIS HC $3.00 CSCL 20K

Criteria are presented for the prediction of panel flutter, determination of its occurrence, design for its prevention, and evaluation of its severity. Theoretical analyses recommended for the prediction of flutter stability boundaries, vibration amplitudes, and frequencies for several types of panels are described. Vibration tests and wind tunnel tests are recommended for certain panels and environmental flow conditions to provide information for design of verification analysis. Appropriate design margins on flutter stability boundaries are given and general criteria are

presented for evaluating the severity of possible short-duration, limited-amplitude panel flutter on nonreusable vehicles. Author

N73-11933# Naval Postgraduate School, Monterey, Calif.
ANALYSIS OF INITIALLY BENT TWO SPAN COLUMNS M.S. Thesis
Robert Bowers Ploeger Jun. 1972 57 p refs
(AD-747075) Avail: NTIS CSCL 13/13

A study of single-span initially bent columns is made and extended to include two-span columns. The axial force in these columns results from heating (or an equivalent) and from bowing. A snap-through phenomenon is considered in the analysis of the single-span and observations are made concerning snap-through in the two-span column. A digital computer program is developed to carry out the analysis and a description of the program enables its use by anyone familiar with the FORTRAN language. Author (GRA)

N73-11934*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MULTIMATERIAL LAMINATION AS A MEANS OF RETARDING PENETRATION AND SPALLATION FAILURES IN PLATES
John D. DiBattista and Donald H. Humes Washington Nov. 1972 36 p refs
(NASA-TN-D-6989; L-8444) Avail: NTIS HC $3.00 CSCL 20K

Experimental data are presented which show that hypervelocity impact spallation and penetration failures of a single solid aluminum plate and of a solid aluminum plate spaced a distance behind a Whipple meteor bumper may be retarded by replacing the solid aluminum plate with a laminated plate. Four sets of experiments were conducted. The first set of experiments was conducted with projectile mass and velocity held constant and with polycarbonate cylinders impacted into single plates of different construction. The second set of experiments was done with single plates of various construction and aluminum spherical projectiles of similar mass but different velocities. These two experiments showed that a laminated plate of aluminum and polycarbonate or aluminum and methyl methacrylate could prevent spallation and penetration failures with a lower areal density than either an all-aluminum laminated plate or a solid aluminum plate. The aluminum laminated plate was in turn superior to the solid aluminum plate in resisting spallation and penetration failures. In addition, through an example of 6061-T6 aluminum and methyl methacrylate, it is shown that a laminated structure ballistically superior to its parent materials may be built. The last two sets of experiments were conducted using bumper-protected main walls of solid aluminum and of laminated aluminum and polycarbonate. Again, under hypervelocity impact conditions, the laminated main walls were superior to the solid aluminum main walls in retarding spallation and penetration failures. Author

N73-11935# Lockheed Missiles and Space Co., Palo Alto, Calif.
CARRYING CAPACITY OF CYLINDRICAL SHELLS SUBJECTED TO DYNAMIC EXTERNAL PRESSURE
Iu. K. Bivin and A. A. Naida 1972 7 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 6, no. 10, 1970 p 28-34
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The results are reported of experiments to determine the safe values of dynamic external pressure on the surface of shells. The theoretical bounds are estimated on the basis of linear shell theory. Author

N73-11936# Lockheed Missiles and Space Co., Palo Alto, Calif.
STATE OF THE ART OF THE THEORY OF MULTILAYER SHELLS
E. I. Grigoliuk and F. A. Kogan 1972 18 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 8, no. 6, 1972 p 3-17
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The construction and application of shell-type, thin-walled structures are described. The modifications of the general theory of multilayer shells in which transverse shears and transverse normal strains occur are analyzed. The theory of finite deflection of shallow multilayered shells of a linearly viscoelastic material for each layer is discussed. A geometrically nonlinear theory of thin elastic multilayered anisotropic shallow shells subjected to transverse load and longitudinal heating is developed. The finite deflection equation of thin elastic multilayered shells of arbitrary shape using a static means is presented. Mathematical models are included to clarify the theory. Author

N73-11937# Lockheed Missiles and Space Co., Palo Alto, Calif.
ON THE QUESTION OF AN EXPERIMENTAL CONSTRUCTION OF YIELD SURFACES
L. M. Kachanov [1972] 5 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Mekh. Tverd. Tala (Moscow), no. 4, 1971 p 177-179
Avail: NTIS HC $3.00; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The characteristics of yield surfaces for a hardening body as a function of the preliminary loading path are discussed. The difficulties of constructing yield surfaces and the errors associated with conducting tests are presented. The determination of the yield point by means of the proportionality limit is anlayzed. In constructing the primary yield surface for a metal with a sufficiently high yield point and comparatively little hardening, the outlines of the yield surface are noticeably independent of the magnitude of the given tolerance if the tolerance is not too small.
Author

N73-11938# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Bridge Building and Structural Engineering.
SHEAR AND TORSION IN REINFORCED CONCRETE BEAMS Ph.D. Thesis
Tage Petersson Natl. Swed. Inst. for Bldg. Res. Jun. 1972 282 p refs
(Grant SWEDCBR-C-387)
(D-10-1972) Avail: NTIS HC $16.25; Svensk Byggtjaenst, Stockholm Sw.Kr.38

The internal forces and critical loads in concrete beams reinforced with stirrups are studied. Three types of loading are examined: simultaneous bending and shear; torsion; simultaneous torsion, bending and shear. Comparisons are made with tests and confirm assumptions relating to the internal loads.
Author (ESRO)

N73-11939# Polytechnic Inst. of Brooklyn, Freeport, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
LINEAR AND NONLINEAR ANALYSIS OF SHELLS
Vytas Svalbonas and Anthony E. Armenakas May 1972 213 p refs
(Contract F44620-69-C-0072; AF Proj. 9783)
(AD-745967; PIBAL-72-20; AFOSR-72-1110TR) Avail: NTIS CSCL 20/11

The solution of problems involving static equilibrium, natural vibrations, and stability of arbitrary, stiffened, shells of revolution, subjected to symmetric static loading is reviewed using a numerical integration technique combined with the direct stiffness method, and compared to solutions employing other numerical techniques, such as finite differences and finite elements. The numerical integration technique is extended to linear and nonlinear analysis of static equilibrium, stability, and vibrations under the influence of initial prestress, of arbitrary shells of revolution subjected to general unsymmetric (no line of symmetry) loadings. The coupling of the Fourier harmonics of the various shell functions in the case of nonlinear analysis are presented for a spherical cap subjected to unsymmetric static loading. Moreover, the classical buckling load is established for a prolate spheroid subject to hydrostatic pressure, and for an example shell of revolution of complex geometry subjected to a complex loading system.
Author (GRA)

N73-11940# Aerospace Corp., El Segundo, Calif.
RESPONSE OF A CURVED ELASTIC SEGMENT TO SHOCK-WAVE ENGULFMENT LOADS Technical Report, 1 Jul. 1971 - 1 May 1972
John Paul Jones 30 Jun. 1972 37 p refs
(Contract F04701-71-C-0172)
(AD-745962; SAMSO-TR-72-176; TR-0172(2240-30)-5) Avail: NTIS CSCL 20/1

The short time response of a cylindrical, elastic segment to shock-wave engulfment is treated. The exact equations of the

linear theory of elasticity are used instead of the usual integrated equations of ring theory. Using a relatively new mathematical technique, described in the report, the authors easily identify the focusing effects due to the curved geometry. This work explains some anomalous results obtained while subjecting curved aluminum specimens to loads produced by shock waves.
Author (GRA)

N73-11941# California Univ., Los Angeles. School of Engineering and Applied Science.
ACOUSTIC EMISSION AND FRACTURE MECHANICS TESTING OF METALS AND COMPOSITES
A. S. Tetelman Jul. 1972 48 p refs Presented at US-Japan Joint Symp. on Acoustic Emission, Tokyo
(Contract DAHC04-69-C-0008; DA Proj. 2O0-61102-B-32-D)
(AD-746261; UCLA-ENG-7249; AROD-8016-6-MC; TR-7) Avail: NTIS CSCL 14/2

Acoustic emission testing has found many uses in recent years and new applications are constantly being uncovered. One of the most fruitful areas for application lies in the characterization of microscopic processes of yielding and fracture, and macroscopic processes of slow crack growth and onset of fast crack propagation. This paper has described these processes and empahsized that the total counts and count rate depend on the energy released per event and the density of events per unit of deformation. The models presented herein are first order approximations which await confirmation. Author (GRA)

N73-11942# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
COMPUTER SOLUTIONS OF PLASTICITY PROBLEMS
Philip G. Hodge, Jr. 1972 35 p refs
(Contract N00014-67-A-0113-0025; NR Proj. 064-429)
(AD-746175; H1-3) Avail: NTIS CSCL 20/11

In recent years, finite-element methods have proved to be a very useful tool in obtaining solutions to problems of practical importance for both elastic and inelastic structures. Because the need for solutions is so great, and because the results predicted by finite-element solutions are reasonable, primary interest has been in the establishment of efficient computer programs for the solution of large scale problems. As a result, some theoretical considerations which may be important in extended applications of the methods have tended to be overlooked. The present paper reviews the current state-of-the-art, focuses on some of these questions and recent work that has been done towards obtaining answers, and suggests some desirable directions for future research. Author (GRA)

N73-11943# Army Foreign Science and Technology Center, Charlottesville, Va.
CORRESPONDENCE BETWEEN THE ENERGY CRITERION FOR FRACTURE AND MATHEMATICAL MODELING OF STRAIN EFFECTS AT THE TIP OF SLIT-CRACKS
E. M. Morozov 3 May 1972 19 p refs Transl. into ENGLISH of the publ. "O Spptvetstvoo Mezdu Energeticheskim Kriteriem Razrusheniya i Motematickeskim Modelirovanihym Yavlenii Deformatsii V Kontse Razrezpv-Treshchin" Moscow
(AD-746010; FSTC-HT-23-399-72) Avail: NTIS CSCL 20/11

Investigation of the phenomena of crack formation in brittle bodies is associated with the combination, on one hand, of the methods and formulations of the classical theory of elasticity and, on the other, with certain special physical effects associated with the formation of discontinuities within deformable solid bodies. An article by Yu. P. Rayzer appeared in Uspekhi fizicheskikh nauk (Advances in the Physical Sciences) attempting to clarify the status of the theory of crack formation and also to attempt to refute several published critical remarks. Several well known principles of the theory of crack formation were accurately stated in the article. Even so, this article can divert the reader from a correct appreciation of the fundamental simple concepts on which the theory of crack formation rests. Author (GRA)

N73-11944# Alabama Univ. Research Inst., Huntsville. Research Inst.
GENERAL MIXED FINITE ELEMENT METHODS OF NONLINEAR CONTINUA
D. R. Bhandari and J. T. Oden Apr. 1972 32 p refs
(Contract F44620-69-C-0124; AF Proj. 9560)
(AD-745994; UARI-RR-123; AFOSR-72-1126TR) Avail: NTIS CSCL 20/11

General mixed finite element models of the nonlinear thermomechanical response of dissipative media are constructed. A number of existing specialized finite element models are derived from the general formulation presented in this paper.
Author (GRA)

N73-11945# Texas Univ., Austin. Electronics Research Center.
MEASUREMENT OF AXIAL VELOCITY PROFILES AND RESULTING ACOUSTICAL FIELDS OF A ROD
L. J. Nowotny and E. L. Hixson 18 Jan. 1972 104 p refs
(Contract F44620-71-C-0091; AF Proj. 4751)
(AD-747209; TR-118; AFOSR-72-0615TR) Avail: NTIS CSCL 20/11

Sinusoidal stress waves over the frequency range 10-100 KHz were transmitted down a cylindrical aluminum rod twelve feet long and one and one-half inches in diameter. Using a modified Twyman-Green interferometer and a high sensitivity, fast rise time photo-diode radial distributions of axial displacement were measured at the radiating face of the rod while it was under continuous-wave excitation. Measurements verified the almost piston-like displacement profiles for low frequencies and indicated increased distortion of the face with increasing frequency. Nodal cylinders of axial displacement in the rod were found to occur beginning at about 30 KHz with only the lowest symmetric mode propagating in the rod. Author (GRA)

N73-11946# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
BOUNDS TO BENDING FREQUENCIES AND MODE SHAPE ESTIMATES FOR FREE NONUNIFORM BEAMS WITH ATTACHED MASSES. PART 1: ANALYSIS AND RESULTS
N. Rubinstein and J. T. Stadter May 1972 85 p refs
(Contract N00017-72-C-4401)
(AD-747241; APL-TG-1189-A-Pt-1) Avail: NTIS CSCL 13/13

The report presents procedures for computing upper and lower bounds to bending frequencies and estimates of mode shapes of beams with piecewise constant stiffness and mass and with elastically attached masses. The Rayleigh-Ritz procedure was used to obtain the upper bounds and the mode shapes; lower bounds were obtained using the method of Intermediate Problems. Several features of these methods are that they give upper and lower bounds that bracket the true frequencies; they are computationally fast, accurate, and easy to use; they can handle beams with a large number of stiffness and mass variations and many elastically attached masses; and they yield improvable bounds, i.e., as the sizes of the matrices used in the numerical computations are increased, the upper and lower bounds converge to the true frequencies. Author (GRA)

N73-11947# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
BOUNDS TO BENDING FREQUENCIES AND MODE SHAPE ESTIMATES FOR FREE NONUNIFORM BEAMS WITH ATTACHED MASSES. PART 2: PROGRAM USER'S GUIDE
N. Rubinstein and J. T. Stadter Jul. 1972 84 p
(Contract N00017-72-C-4401)
(AD-747242; APL-TG-1189-B-Pt-2) Avail: NTIS CSCL 13/13

The report describes the use of a digital computer program for finding bounds to bending frequencies and estimates of mode shapes of free nonuniform beams with piecewise constant stiffness and mass and with elastically attached masses. Detailed instructions for the use of the program are given, along with a description of various subroutines, input and output data, and program listings. The use of the program is illustrated by an example in which the vibration characteristics are computed for a beam with two discontinuities in stiffness and mass per unit length and with three elastically attached masses.
Author (GRA)

N73-11948# Polytechnic Inst. of Brooklyn, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
PROPAGATION OF AXISYMMETRIC WAVES ACROSS THE INTERFACE BETWEEN TWO SEMI-INFINITE RODS OF DIFFERENT MATERIALS Interim Report
J. M. Housner and A. E. Armenakas Feb. 1972 40 p refs
(Contract F44620-69-C-0072; AF Proj. 9782)

(AD-746721; PIBAL-72-6; AFOSR-72-0101TR) Avail: NTIS CSCL 20/11

In the investigation, an analytical study is presented of the propagation of axisymmetric harmonic waves in an infinite rod composed of two semi-infinite rods, of different isotropic materials, joined end to end. A source, located at an infinite distance from the interface separating the two rods, excites a continuous train of waves travelling toward the interface. The waves which are reflected and transmitted through the interface were studied using two approximate methods: first, by superimposing the modes of wave propagation of an approximate theory and, second, by superimposing a large number of exact (three-dimensional elasticity) modes of wave propagation. Author (GRA)

N73-11949# Watervliet Arsenal, N.Y.

AN INVESTIGATION OF VIBRATIONS OF LAMINATED PLATES WITH MICROSTRUCTURE

Charles R. Thomas Jun. 1972 62 p refs

(DA Proj. 1F0-61102-A-35-D)

(AD-746951; WVT-7233) Avail: NTIS CSCL 11/7

Simple thickness frequencies for the C. T. Sun effective stiffness theory for flexural and extensional vibrations of laminated plates are compared to exact simple thickness frequency results previously obtained from the effective stiffness continuum theory and are found to differ by a factor of 12/pi squares. Following Mindlin, Sun's plate theory is rederived and modified with three velocity correction factors introduced through the kinetic energy to make the plate theory consistent with the continuum theory for simple thickness modes. A comparison of simple thickness frequencies for both theories gives the correction factors as Ki = square root of 12/pi,i = 1,2,3. The velocity corrected flexural equations are reduced for the case of a plate strip and frequency equations are derived for simply supported edges by the method of M. Levy, where solutions harmonic in plate width are assumed and the boundary conditions for simple supports are automatically satisfied. Author (GRA)

N73-11950# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Engineering Mechanics.

LOCAL STRESSES NEAR DEEP SURFACE FLAWS UNDER CYLINDRICAL BENDING FIELDS

M. A. Schroedl and C. W. Smith Aug. 1972 54 p refs Presented at 6th Natl. Symp. on Fracture Mech., Philadelphia, 28-30 Aug. 1972

(Contract DAAF07-69-C-0444)

(AD-746976; VPI-E-72-9) Avail: NTIS CSCL 20/11

A series of tests was performed using the stress freezing and slicing technique of photoelasticity in order to obtain the stress fields near points of maximum flaw penetration and where the crack border intersects the tensile surface of the plate for naturally grown surface flaws under fields of remote cylindrical bending. Geometries investigated ranged over crack depth to crack length ratios of approximately 0.13 to 0.55 and over crack depth to plate thickness ratios of approximately 0.27 to 0.79. Results were compared with several approximate theories on the basis of graphs of normalized maximum in plane shear stress versus normalized distance from the crack tip and stress intensity factor in order to assess the validity of the several field theories. A numerical technique for data conditioning was employed from which the stress intensity factors were computed and compared with theoretical values. Author (GRA)

N73-11951# Technion - Israel Inst. of Tech., Haifa. Material Mechanics Lab.

REPRESENTATION OF TIME DEPENDENT CHARACTERISTICS OF METALS Interim Report

Sol R. Bodner and Yehuda Partom May 1972 29 p refs Presented at 8th Congr. of the Intern. Council of the Aeron. Sci. (ICAS), Amsterdam, Aug. 1972 Submitted for publication

(Contract F44620-72-C-0004; AF Proj. 9782)

(AD-746340; MED-35; AFOSR-72-1328TR; SR-1) Avail: NTIS CSCL 13/13

A new approach to the representation of time dependent inelastic material behavior is described. Realistic properties such as strain hardening, strain rate effects, and anelasticity can be incorporated in this description which is particularly well suited for the computational solution of structural problems involving cyclic loading and large inelastic strains. Application to technological metals such as titanium is indicated. Author (GRA)

N73-11952# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.

CREEP BUCKLING OF PLATES AND SHELLS

Nicholas J. Hoff Jul. 1972 52 p refs

(Contract N00014-67-A-0112-0003; NR Proj. 064-425)

(AD-746475; SUDAAR-443) Avail: NTIS CSCL 20/11

A review is presented of the fundamental considerations that enter into the calculation of the buckling of plates and shells whose material deforms in consequence of nonlinear creep. Results are given of analyses that have been carried out for flat plates subjected to edge-wise compression and for circular cylindrical shells subjected to uniform axial compression, to a uniform external pressure and to a constant bending moment. The character of the behavior of these structural elements after buckling is also discussed. Author (GRA)

N73-11953# Stanford Univ., Calif. Dept. of Applied Mechanics.

THERMAL INSTABILITIES IN A VISCOELASTIC ROD UNDER CYCLIC LOADING Interim Technical Report

Subrata Mukherjee Jun. 1972 40 p refs

(Contract N00014-67-A-0112-0060; NR Proj. 064-471)

(AD-746470; SU-SUDAM-72-9) Avail: NTIS CSCL 20/11

Thermal instabilities in a viscoelastic rod under cyclic loading are discussed by determining the stresses and temperature in a viscoelastic rod insulated on its lateral surface and driven by a sinusoidal stress at one end. Temperature dependence of the complex Young's modulus of the rod and the effect of thermome chanical coupling are included in the analysis. A method of finite differences is used to directly determine the steady state stresses and temperature without obtaining the complete time history of the process. The iterative algorithm used is very useful and converges rapidly for a wide range of driving stress amplitudes and frequencies. It is found that rapid rise of temperature to dangerous levels occurs for relatively low values of driving stress amplitudes, especially if the driving frequency is close to one of the critical frequencies of the rod. Drastic softening of the rod leads to large strains. Thus, failure of the rod could occur at low values of the driving stress.

Author (GRA)

N73-11954# Alabama Univ. Research Inst., Huntsville.

NOTE ON AN APPROXIMATE METHOD FOR COMPUTING CONSISTENT CONJUGATE STRESSES IN ELASTIC FINITE ELEMENTS Interim Report

J. T. Oden and J. N. Reddy Apr. 1972 19 p refs

(Contract F44620-69-C-0124; AF Proj. 9560; Proj. Themis)

(AD-746024; UARI-RR-124; AFOSR-72-1127TR) Avail: NTIS CSCL 20/11

An approximate procedure for implementing the idea of consistent conjugate stresses in an efficient way is described. Examples are given which show that the approximate consistent stresses are in very close agreement with the usual consistent stress distribution and both provide good approximations to exact stresses. Author (GRA)

N73-11955# Iowa Univ., Iowa City. Dept. of Mechanics and Hydraulics.

EVALUATION OF THE EDGE AND MEMBRANE EFFECTS IN MODERATELY THICK BEAMS BY A SINGULAR PERTURBATION TECHNIQUE Ph.D. Thesis

Frank Juei-wan Hsiu Jul. 1972 141 p refs

(Contract DAAF03-69-C-0014; Proj. Themis)

(AD-746985; THEMIS-UI-43) Avail: NTIS CSCL 20/11

Engineering theories in the analysis of stress and displacement fields embody many assumptions. While the tractability of these simplified models is enhanced, the validity of their solution becomes doubtful once the original assumptions are violated. Ordinary beam theory, for example, is obviously unsuitable for thick beam problems. As a matter of fact, it fails to describe the significant phenomena of membrane and end effects, which are physically apparent. As a first step toward developing a theory and a technique which will be applicable to other structural elements as well, the higher order mathematical models of an elastic, linear, homogeneous, isotropic, moderately thick beam are derived. A limiting case of the higher order equation, when

depth-span ratio approaches zero, generalizes the Euler-Bernoulli beam equation. A singular perturbation technique is employed to obtain uniformly valid expansion solutions for the higher order equation. Author (GRA)

N73-11956# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
ANALYSIS OF THE DYNAMICS OF ELASTIC STRUCTURES BY THE FINITE ELEMENT METHOD Ph.D. Thesis
Richard J. Talbot Jun. 1972 183 p refs
(AD-747283; DS/MC-72-1) Avail: NTIS CSCL 20/11

The finite element displacement method has been used to investigate the transient response and dispersive behavior of elastic structures. An improved technique for integrating the finite element equation of motion has been developed. The stability characteristics of the algorithm have been determined and the critical time step length has been evaluated. A finite element formulation has been derived to study the dispersive characteristics of elastic waveguides. Several new finite elements, which include the wavenumber as a parameter, have been formulated. Dispersion curves for the circular rod, the square bar, and an equilateral triangle waveguide have been obtained. The versatility of the method has been illustrated by obtaining the longitudinal mode spectrum for a unidirectional fiber reinforced composite. The new finite time step algorithm was used to study the response of a finite length fixed-free circular rod to a step pressure applied at the free end. Author (GRA)

N73-11957# Army Foreign Science and Technology Center, Charlottesville, Va.
RELATIONSHIP BETWEEN THE THEORY OF SAINT-VENANT-LEVY-MISES AND THE THEORY OF SMALL ELASTICO-PLASTIC DEFORMATIONS
A. A. Ilyushin 3 Jul. 1972 21 p refs Transl. into ENGLISH from Prikl. Mat. Mekh. (USSR), v. 9, 1945 p 207-218
(AD-747296; FSTC-HT-23-907-72) Avail: NTIS CSCL 20/11

The author proves that the validity of the generalized theory of small elastico-plastic deformations provides the general condition the partial if Xi with respect to lambda = 0 where Xi is a so-called tensor of similitude and lambda is a value independent of x, y, z, but characterizing the sequence of the different stressed states of the body. From this two statements arise: (1) The theory of the small elastico-plastic deformations is a particular case of the St. Venant-Levy-Mises theory of flow; and (2) For the condition the partial if Xi with respect to lambda = 0 the Hencky-Mises theory of small deformations follows from the theory of flow. Moreover, the above-mentioned condition leads to new expressions for the laws of the theory of small plastic deformations, since every intermediate stressed state after unloading may be taken as an initial state. Author (GRA)

N73-11958# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPECTRUM OF NATURAL FREQUENCIES FOR THE SYSTEM ELASTIC PLATE/FLUID
V. N. Buivol and Yu. R. Shevchuk 20 Jun. 1972 14 p refs Transl. into ENGLISH from Gidromekhanika (USSR), no. 17, 1971 p 3-8
(AF Proj. 7343)
(AD-747206; FTD-HT-23-779-72) Avail: NTIS CSCL 20/11

A solution obtained by Diatlovskii et al (1969) to the problem of the natural vibrations of an elastic wall in a compressible inviscid fluid is used as a basis in a numerical analysis of the natural frequency spectrum of the system vibrations and of the influence of various factors on the spectrum. The analysis leads to a simple formula for calculating the natural frequencies of a cantilever plate in a fluid. Without requiring additional calculations, the formula reveals the frequency dynamics as a function of the principal parameters. Author (GRA)

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N73-11959 National Lending Library for Science and Technology, Boston Spa (England).
IGNITION OF A DROPLET OF FUEL
G. A. Varshavskii, D. V. Fedoseev, and A. D. Frank-Kamenetskiy Sep. 1972 5 p Transl. into ENGLISH from the publ. "Shestaya Mezhruzov. Konf. po Voprosam Ispateniya Goreniya i Gazevoi Dinamiki Dispersnykh Sistem, Oct. 1966" Odessa, 1968 p 91-95 (NLL-RTS-7169) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.50: 2 NLL photocopy coupons

The ignition site and ignition delay time are determined for a fuel droplet, based on the following assumptions: (1) no burn-up of fuel vapor until the moment of ignition, (2) infinitesimal thermal and concentrational relaxation time, (3) similarity of the fields of surplus concentration and temperature, and (4) temperature independent thermophysical parameters. The distribution of the temperature is determined by the fundamental solution of the stationary equation of thermal conductivity for spheres, and it is shown that the ignition delay time depends greatly on the droplet size. F.O.S.

N73-11960 National Lending Library for Science and Technology, Boston Spa (England).
PRESSURE DROP IN PLATE HEAT EXCHANGERS
A. M. Maslov Sep. 1972 6 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Pishch. Tekhnol. (USSR), no. 5, 1971 p 131-134
(NLL-RTS-7505) Avail: Natl. Lending Library, Boston Spa, Engl.: £0.50; 2 NLL photocopy coupons CSCL 20M

The pressure drop in the gap between plates with sinusoidal corrugations is determined for a laminar flow of viscous Newtonian liquid by substitution of the coefficient of proportionality in the formula for a straight slot channel. F.O.S.

N73-11961 Engineering Sciences Data Unit, London (England).
THERMAL CONDUCTIVITY OF LIQUID GLYCOLS, GLYCEROL AND THEIR AQUEOUS SOLUTIONS
Feb. 1970 24 p refs Sponsored by Inst. of Chem. Eng. and Inst. of Mech. Eng.
(ESDU-70004) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Curves for determining the thermal conductivity of glycols, glycerols and their aqueous solutions are presented. The pressure effects are considered. Tables showing melting and boiling points for each liquid are included. F.O.S.

N73-11962 Engineering Sciences Data Unit, London (England).
CONVECTIVE HEAT TRANSFER DURING FORCED CROSS FLOW OF FLUIDS OVER A CIRCULAR CYLINDER, INCLUDING FREE CONVECTION EFFECTS
May 1969 29 p refs Sponsored by Inst. of Chem. Engr. and Inst. of Mech. Engr.
(ESDU-69004-Amend-A) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Convective heat transfer data in non-dimensional form, are presented for the crossflow of a single-phase Newtonian fluid over a circular cylinder under conditions of negligible thermal radiation and zero heat generation within the fluid. The cases of horizontal and vertical cylinders are covered and the data apply for gases and for liquids with the exception of liquid metals. The regions in which the data may be applied are shown. Author

N73-11963 Engineering Sciences Data Unit, London (England).
FORCED CONVECTION HEAT TRANSFER IN CIRCULAR TUBES. PART 2: DATA FOR LAMINAR AND TRANSITIONAL FLOWS INCLUDING FREE CONVECTION EFFECTS
Feb. 1968 24 p refs Revised Sponsored by Inst. Chem.

Engr. and Inst. Mech. Engr.
(ESDU-68006-Amend-A-Pt-2) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Curves for determining the heat transfer coefficient for laminar flow in tubes are presented. The effects of free convection and wall temperature are considered. F.O.S.

N73-11964 Engineering Sciences Data Unit, London (England).
FORCED CONVECTION HEAT TRANSFER IN CIRCULAR TUBES. PART 1: CORRELATIONS FOR FULL-DEVELOPED TURBULENT FLOW: THEIR SCOPE AND LIMITATIONS
Apr. 1967 26 p refs Sponsored by Inst. of Chem. Engr. and Inst. of Mech. Engr.
(ESDU-67016) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

The nondimensional parameters governing forced convection heat transfer under simple idealized conditions are introduced. Secondary factors are considered which in practice may also influence the heat transfer coefficient. Tests are quoted that can be used to determine which of these factors, namely, free convection, tube entrance effects, variable fluid properties, heat flux distribution, Mach number and surface roughness, are significant in any given circumstances. Author

N73-11965 Engineering Sciences Data Unit, London (England).
FORCED CONVECTION HEAT TRANSFER IN CIRCULAR TUBES. PART 3: FURTHER DATA FOR TURBULENT FLOW
Aug. 1968 27 p refs Sponsored by the Institution of Mech. Engr. and the Institution of Chem. Engr.
(ESDU-68007-Pt-3) Copyright. Avail: On subscription from Engineering Sciences Data Unit, 251-259 Regent Street, London W1R 7AD

Forced convection heat transfer is considered for a single-phase flow of Newtonian fluid in a smooth, straight, constant area, circular tube with negligible thermal radiation and negligible heat generation (i.e. viscous dissipation and heat of reaction) within the fluid. Secondary factors (free convection, tube entrance effect, variable fluid properties and variable heat flux distribution) are considered which invalidate the assumptions of the idealized conditions. Author

N73-11966*# National Bureau of Standards, Boulder, Colo. Cryogenics Div.
THERMOPHYSICAL PROPERTIES OF HELIUM-4 FROM 4 TO 3000 R WITH PRESSURES TO 15000 PSIA
Robert D. McCarty Sep. 1972 147 p refs
(NASA Order T-1813-A)
(NASA-CR-128445; NBS-TN-622) Avail: NTIS; SOD $1.25 as C 13.46:622 CSCL 20M

Data on many of the properties of helium commonly used in engineering calculations are compiled over as wide a temperature and pressure range as is practical. These properties are presented in a form which is convenient to the engineer. All of these properties have been critically evaluated and represent the best values for that property at this time. Author

N73-11967*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
HEAT PIPE INVESTIGATIONS
James P. Marshburn May 1972 53 p refs
(NASA-TM-X-66072; X-322-72-153) Avail: NTIS HC $4.75 CSCL 20M

The OAO-C spacecraft has three circular heat pipes, each of a different internal design, located in the space between the spacecraft structural tube and the experiment tube, which are designed to isothermalize the structure. Two of the pipes are used to transport high heat loads, and the third is for low heat loads. The test problems deal with the charging of the pipes, modifications, the mobile tilt table, the position indicator, and the heat input mechanisms. The final results showed that the techniques used were adequate for thermal-vacuum testing of heat pipes. Author

N73-11968*# Virginia Univ., Charlottesville. Div. of Mechanical and Aerospace Engineering.
FURTHER ANALYTICAL STUDY OF HYBRID ROCKET COMBUSTION Final Report
W. S. Y. Hung, C. S. Chen, and J. K. Haviland Oct. 1972 47 p refs
(Contract NAS1-10210)
(NASA-CR-112201; AEEP-4041-106-72U) Avail: NTIS HC $4.50 CSCL 21B

Analytical studies of the transient and steady-state combustion processes in a hybrid rocket system are discussed. The particular system chosen consists of a gaseous oxidizer flowing within a tube of solid fuel, resulting in a heterogeneous combustion. Finite rate chemical kinetics with appropriate reaction mechanisms were incorporated in the model. A temperature dependent Arrhenius type fuel surface regression rate equation was chosen for the current study. The governing mathematical equations employed for the reacting gas phase and for the solid phase are the general, two-dimensional, time-dependent conservation equations in a cylindrical coordinate system. Keeping the simplifying assumptions to a minimum, these basic equations were programmed for numerical computation, using two implicit finite-difference schemes, the Lax-Wendroff scheme for the gas phase, and, the Crank-Nicolson scheme for the solid phase. Author

N73-11969*# Purdue Univ., Lafayette, Ind.
NONEQUILIBRIUM COMBUSTION EFFECTS IN SUPERSONIC STREAMS
R. M. Jensen, C. A. Bryce, and B. A. Reese May 1972 48 p refs
(Grant NGR-15-005-013)
(NASA-CR-120932) Avail: NTIS HC $4.50 CSCL 21B

This research program is a theoretical and experimental investigation of the effect of nonequilibrium conditions upon the performance of combustors employing supersonic flows. Calculations and experiments are made regarding the effects on the ignition of hydrogen of the nonequilibrium species (free radicals, atoms, water vapor, etc.) obtained using vitiated air. Results of this investigation show that the nonequilibrium free-radical content from a supersonic vitiated air source will cause early ignition of the hydrogen. An analysis of heated air expended from a high-temperature source to test section conditions also indicates that there is sufficient free radical content in the incoming flow to cause early ignition. Water vapor, an inherent contaminent in the generation of vitiated air, was found to reduce the ignition delay period under the experimental conditions considered. Author

N73-11970*# Aerojet Liquid Rocket Co., Sacramento, Calif.
HYDROGEN FILM/CONDUCTIVE COOLING Technical Report, 29 Jun. 1970 - 30 Sep. 1971
R. L. Ewen Nov. 1972 220 p refs
(Contract NAS3-14343)
(NASA-CR-120926) Avail: NTIS HC $13.00 CSCL 20M

Small scale nozzle tests using heated nitrogen were run to obtain effectiveness and wall heat transfer data with hydrogen film cooling. Effectiveness data are compared with an entrainment model developed from planar, unaccelerated flow data. Results indicate significant effects due to flow turning and acceleration. With injection velocity effects accounted for explicitly, heat transfer correlation coefficients were found to be the same with and without film cooling when properties are evaluated at an appropriate reference temperature for the local gas composition defined by the coolant effectiveness. A design study for an O2/H2 application with 300 psia (207 N/sq cm) chamber pressure and 1500 lbs (6670 N) thrust indicates an adiabatic wall design requires 4 to 5 percent of the total flow as hydrogen film cooling. Internal regenerative cooling designs were found to offer no reduction in coolant requirements. Author

N73-11971*# Wisconsin Univ., Madison. Dept. of Mechanical Engineering.
STUDIES OF OSCILLATORY COMBUSTION AND FUEL VAPORIZATION Final Report
G. L. Borman, P. S. Myers, and O. A. Uyehara Aug. 1972 99 p refs
(Grant NGR-50-002-017)
(NASA-CR-120974) Avail: NTIS HC $7.00 CSCL 21B

Research projects involving oscillatory combustion and fuel vaporization are reported. Comparisons of experimental and

theoretical droplet vaporization histories under ambient conditions such that the droplet may approach its thermodynamic critical point are presented. Experimental data on instantaneous heat transfer from a gas to a solid surface under conditions of oscillatory pressure with comparisons to an unsteady one-dimensional model are analyzed. Droplet size and velocity distribution in a spray as obtained by use of a double flash fluorescent method were investigated. Author

N73-11972*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
METHOD AND APPARATUS FOR DETERMINING THERMOPHYSICAL PROPERTIES OF SPECIMENS Patent Application
Robert A. Jones, inventor (to NASA) Filed 18 Aug. 1972 12 p
(NASA-Case-LAR-11053-1; US-Patent-Appl-SN-281875) Avail: NTIS HC $3.00 CSCL 20M

A method for determining the thermophysical properties of wind tunnel models is discussed. The procedure consists of exposing a model which is coated with a phase-change temperature indicator material to the airstream in the wind tunnel. A movie camera is used to record the change in phase of the coatings. Heat rate is determined by the thin skin calorimeter equation and the heat rate is used to calculate the thermophysical value from the transient one dimensional heat conduction equation for a semi-infinite solid subjected to a step heat input at a constant rate. NASA

N73-11973*# California Inst. of Tech., Pasadena. Daniel and Florence Guggenheim Jet Propulsion Center.
SOME CONSIDERATIONS IN THE COMBUSTION OF AP/COMPOSITE PROPELLANTS
R. N. Kumar Aug. 1972 120 p refs Prepared for JPL (Contract NAS7-100)
(NASA-CR-129198) Avail: NTIS HC $8.00 CSCL 21B

Theoretical studies are presented on the time-independent and oscillatory combustion of nonmetallized AP/composite propellants. Three hypotheses are introduced: (1) The extent of propellant degradation at the vaporization step has to be specified through a scientific criterion. (2) The condensed phase degradation reaction of ammonium perchlorate to a vaporizable state is the overall rate-limiting step. (3) Gas phase combustion rate is controlled by the mixing rate of fuel and oxidizer vapors. In the treatment of oscillatory combusition, the assumption of quasi-steady fluctuations in the gas phase is used to supplement these hypotheses. In comparison with experimental data, this study predicts several of the observations including a few that remain inconsistent with theoretical results. Author

N73-11974*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
POLLUTION MEASUREMENTS OF A SWIRL-CAN COMBUSTOR
Richard W. Niedzwiecki and Robert E. Jones 1972 16 p refs Presented at the 8th Propulsion Joint Specialists Conf., New Orleans, 29 Nov. - 1 Dec. 1972; sponsored by AIAA and SAE
(NASA-TM-X-68160; E-7218) Avail: NTIS HC $3.00 CSCL 21B

Pollutant levels of oxides of nitrogen, unburned hydrocarbons, and carbon monoxide were measured for an experimental, annular, swirl can combustor. The combustor was 42 inches in diameter, incorporated 120 modules, and was specifically designed for elevated exit temperature performance. Test conditions included combustor inlet temperatures of 600, 900 and 1050 F, inlet pressures of 5 to 6 atmospheres, reference velocities of 69 to 120 feet per second and fuel-air ratios of 0.014 to 0.0695. Tests were also conducted at a simulated engine idle condition. Results demonstrated that swirl can combustors produce oxides of nitrogen levels substantially lower than conventional combustor designs. These reductions are attributed to reduced dwell times resulting from short combustor length, quick mixing of combustion gases with diluent air, and to uniform fuel distributions resulting from the swirl can approach. Radial staging of fuel at idle conditions resulted in increases in combustion efficiencies and corresponding reductions in pollutant levels. Author

N73-11975*# Fansteel, Inc., Newbury Park, Calif. Reflective Laminates Div.
LOW COST FABRICATION OF ABLATIVE HEAT SHIELDS
A. M. Cecka and W. C. Schofield Jun. 1972 56 p (Contract NAS1-11004)
(NASA-CR-112124) Avail: NTIS HC $5.00 CSCL 20M

A material and process study was performed using subscale panels in an attempt to reduce the cost of fabricating ablative heat shield panels. Although no improvements were made in the material formulation, a significant improvement was obtained in the processing methods compared to those employed in the previous work. The principal feature of the new method is the press filling and curing of the ablation material in a single step with the bonding and curing of the face sheet. This method was chosen to replace the hand troweling and autoclave curing procedure used previously. Double-curvature panels of the same size as the flat panels were fabricated to investigate fabrication problems. It was determined that the same materials and processes used for flat panels can be used to produce the curved panels. A design with severe curvatures consisting of radii of 24 x 48 inches was employed for evaluation. Ten low-density and ten high-density panels were fabricated. With the exception of difficulties related to short run non-optimum tooling, excellent panel filling and density uniformity were obtained. Author

N73-11976# Centre National de la Recherche Scientifique, Toulouse (France). Lab. d'Automatique et de ses Applications Spatiales.
DESIGN OF A THERMAL DIFFUSION FURNACE MATHEMATICAL MODEL [ETABLISSEMENT D'UN MODELE MATHEMATIQUE D'UN FOUR A DIFFUSION]
J. P. Babary and F. Roubellat Jul. 1972 12 p refs In FRENCH
(LAAS-NI-CMOAC-72-I-11) Avail: NTIS HC $3.00

An electroglass type thermal diffusion furnace was designed for the heat treatment of large semiconductor plates. A mathematical model is established for the heat transfer between the quartz tube inner wall of the furnace and the gas flow, from which a nonlinear partial differential equation system is obtained. Author (ESRO)

N73-11977# Army Foreign Science and Technology Center, Charlottesville, Va.
STUDY OF HEAT TRANSFER OF LONGITUDINALLY SWEPT SURFACES BY THE UNSTABLE THERMAL REGIME METHOD
V. M. Legkii and Yu. D. Koval 25 Apr. 1972 14 p refs Transl. into ENGLISH from Teplofiz. Teplotekh, (Kiev), no. 15, 1969
(AD-746011; FSTC-HT-23-206-72) Avail: NTIS CSCL 20/13

The study proposes a method for the direct experimental estimation of the rate of thermal flow. Consider a body consisting of a moderately size core the calorimeter and its removable housing with good heat insulating properties tightly fitting on all sides. On opening the housing, with a blow, one brings the calorimeter out of the state of thermal equilibrium, and then again replace its housing. The subsequent process can be regarded as the cooling of the calorimeter in a medium with constant temperature and constant heat transfer coefficient, proportional to the thermal inertia at the core-insulation interface. Numerous and steadily repeated experiments confirmed this point of view. Author (GRA)

N73-11978# Sheffield Univ. (England). Dept. of Chemical Engineering and Fuel Technology.
STUDIES LEADING TO THE REALIZATION OF SUPERSONIC COMBUSTION IN PROPULSION APPLICATION Final Scientific Report
M. T. Jacques, R. Payne, and J. Swithenbank Jun. 1972 37 p refs
(Contract EOOAR-70-0071; AF Proj. 9711)
(AD-746341; HIC-174; AFOSR-72-1333TR) Avail: NTIS CSCL 21/2

The report discusses theoretical and experimental studies of hydrogen mixing and combustion in a high enthalpy (6000K) Mach 3.5 airstream carried out in a combustion driven hypersonic shock tunnel operating with a tailored primary shock Mach number of 10.2 10.6. Results obtained using wall static pressure

measurements indicated that following injection there was a steep compression zone, followed by a re-expansion zone after which the static pressure gradually increased to approach that predicted by complete combustion at test conditions. Direct glow photographs showed clearly positions of heat release zones for the two separate injector configuration. Results obtained from a high response gas composition probe placed in the injector wakes, showed that the hydrogen concentration was smallest in the vortex generator wake at a given axial distance downstream of injection. These results showed that for given fuel throughout the vortex generating injector produced the most efficient mixing. GRA

N73-11979# Army Foreign Science and Technology Center, Charlottesville, Va.
IGNITION OF A DROP OF FUEL
G. A. Varshavskii, D. V. Fedoseev, and A. D. Frank-Kamenetskiy 17 Apr. 1972 9 p Transl. into ENGLISH from the publ. "Shestaya Mezhvuzovskaya Konferentsiya Po Voprosam Isparen-iya, Goreniya i Gazovoy Dinamiki Dispersnykh Sistem" Odessa, 1968 p 91-95
(AD-745868; FSTC-HT-23-326-72) Avail: NTIS CSCL 21/2

The point of ignition and ignition delay period are determined for a drop of radius R sub 0 placed in a medium with temperature T sub infinity assuming that no combustion of fuel vapors occurs before the moment of ignition, Nu = 2, the time of thermal and concentration relaxation is infinitesimal, the Lewis-Semenov criterion is equal to one, and all heat physical quantities are independent of temperature. Author (GRA)

N73-11980# General Applied Science Labs., Inc., Westbury, N.Y.
HIGH SPEED IGNITION AND COMBUSTION CHARACTERISTICS OF STORABLE FUELS USING A HOT GAS PILOT IGNITER Interim Report
Stephen N. Schmotolocha and Raymond B. Edelman Apr. 1972 72 p refs
(Contract F44620-71-C-0014; AF Proj. 9711)
(AD-746063; GASL-TR-773; AFOSR-72-1304TR) Avail: NTIS CSCL 21/2

The report presents the results of a study on the ignition and combustion characteristics of high density storable fuels injected into supersonic and subsonic air streams. The fuels include liquid n-hexane, Shelldyne-H, and magnesium/hexane slurry and a boron/magnesium/hexane slurry. The subsonic and supersonic tests were performed in the same constant area combustor using a pebble bed heater and a vitiated heater, respectively. Autoignition and hot gas piloting were studied over a range of airstream total temperatures from ambient (300K) to 1950K. The results include definition of ignition and stable flame limits and pilot effectiveness parameters. Further evidence of staged ignition and combustion of the metallized slurries was obtained. In addition, a comparison between existing subsonic premixed combustion data and the present diffusion flame results is presented. Author (GRA)

N73-11981# Army Foreign Science and Technology Center, Charlottesville, Va.
INVESTIGATION OF HEAT TRANSFER AT CRITICAL POINT DURING OVERFLOWING OF A PLATE LOCATED NORMALLY TO THE FLOW BY AN AXISYMMETRICAL TURBULENT JET
A. A. Andreyev, V. N. Dakhno, O. F. Tsirlin, B. N. Yudayev, and Ye. I. Fedotov 28 Jul. 1972 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Mashinostro. (Moscow), no. 7, 1970 p 74-79
(AD-747294; FSTC-HT-23-657-72) Avail: NTIS CSCL 20/13

A solution is secured for heat transfer at critical point. A comparison of results of the analytical solution with direct measurements is carried out. A connection between intensification of heat transfer and the degree of turbulence of the jet is demonstrated. Intensification of heat transfer is associated with the arising of a vortical system in the neighborhood of the critical point, the vortex being oriented along the line of the flow. Author (GRA)

34 GENERAL

Includes information of a broad nature related to industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N73-11982*+ National Aeronautics and Space Administration, Washington, D.C.
NASA PATENT ABSTRACTS BIBLIOGRAPHY: A CONTINUING BIBLIOGRAPHY, JULY 1972. SECTION 1: ABSTRACTS
Jul. 1972 178 p refs
(NASA-SP-7039(01)-Section-1) Avail: NTIS HC $3.00 CSCL 05B

About 400 patents and applications for patents introduced into the NASA scientific and technical information system during the period January 1972 through June 1972. Each entry consists of a citation, an abstract, and, in most cases, a key illustration selected from the patent or application for patent. Author

N73-11983# Royal Greenwich Observatory, Herstmonceux (England).
GREENWICH TIME REPORT: TIME AND LATITUDE SERVICE FOR OCTOBER - DECEMBER 1971
R. v. D. R. Woolley Dec. 1971 17 p
Avail: NTIS HC $3.00

Greenwich time and latitude observations for October through December 1971 are presented. Radio time signals and standard frequency emissions are included. Author

N73-11984# Research Inst. of National Defence, Stockholm (Sweden).
ON COMPLEX SYSTEMS [OM KOMPLEXA SYSTEM]
G. Wallen, ed. Aug. 1971 261 p refs Partly in ENGLISH partly in SWEDISH
(FOA-P-C-8280-10) Avail: NTIS HC $15.25

A comparison of the minutes of meetings is presented for joint conferences during the years 1967, 1968 and 1969 on business economics with the Trade School in Gothenburg, on industrial economics with the Royal Technical School, and on scientific theory with Gothenburg University. Author

N73-11985*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EMPLOYEE COMMUNICATION AT THE NASA LANGLEY RESEARCH CENTER M.S. Thesis - Coll. of William and Mary
Richard J. Bendura 1972 110 p refs
(NASA-TM-X-68854) Avail: NTIS HC $7.50

The means of employee communication at the NASA Langley Research Center are reported, and their effectiveness evaluated. The history, purpose, and structure of the organization as well as the employee educational background and salary status are discussed. Some of the approaches used by Langley Research Center management in communicating with their men are addressed and compared with recommendations of experts in employee communication. The results of personal interviews involving both employee and management assessment of management-employee communication are presented and evaluated. Employees need a great deal more recommunication from management providing rationale behind the cancellation of existing projects or the disapproval of proposed research projects. Also NASA management needs to establish a policy and guidelines for the rapid and simultaneous dissemination of all non-restricted information to employees during organizational activities having potential adverse effects on large numbers of personnel. Finally some improvements should be made in employee orientation procedures. Author

N73-11986# Joint Publications Research Service, Arlington, Va.
TRANSLATIONS ON EASTERN EUROPE: SCIENTIFIC AFFAIRS, NO. 275
17 Oct. 1972 61 p Transl. into ENGLISH from various Eastern European publications
(JPRS-57271) Avail: NTIS HC $5.25

Articles concerning the development of and progress in the various theoretical and applied scientific disciplines and technical fields are reported. The administration, structure, personnel, and research plans of leading East European scientific organizations and institutions, particularly the academies of sciences, are also considered. Author

N73-11987*# Martin Marietta Corp., Denver, Colo.
METHODOLOGY FOR THE SYSTEMS ENGINEERING PROCESS. VOLUME 3: OPERATIONAL AVAILABILITY Final Report
James H. Nelson Mar. 1972 146 p refs 3 Vol.
(Contract NAS8-27567)
(NASA-CR-61382; MCR-71-352-Vol-3) Avail: NTIS HC $9.50 CSCL 05A

A detailed description and explanation of the operational availability parameter is presented. The fundamental mathematical basis for operational availability is developed, and its relationship to a system's overall performance effectiveness is illustrated within the context of identifying specific availability requirements. Thus, in attempting to provide a general methodology for treating both hypothetical and existing availability requirements, the concept of an availability state, in conjunction with the more conventional probability-time capability, is investigated. In this respect, emphasis is focused upon a balanced analytical and pragmatic treatment of operational availability within the system design process. For example, several applications of operational availability to typical aerospace systems are presented, encompassing the techniques of Monte Carlo simulation, system performance availability trade-off studies, analytical modeling of specific scenarios, as well as the determination of launch-on-time probabilities. Finally, an extensive bibliography is provided to indicate further levels of depth and detail of the operational availability parameter. Author

N73-11988# Rohr Corp., Chula Vista, Calif.
AIRLINE ECONOMIC IMPACT COMPUTER MODEL. VOLUME 1: DETAILED DISCUSSION Final Report
Gregory W. Jordan, Sydney X. Smith, William L. Metzger (Mitchell Res. Assoc., San Diego, Calif.), and Ralph C. Gibson (Mitchell Res. Assoc., San Diego, Calif.) Jun. 1972 306 p refs
(Contract DOT-FA72WA-2699)
(FAA-EQ-72-4-Vol-1) Avail: NTIS HC $17.50

A computer model is described which determines the economic impact of aircraft retrofit on the airline industry. The purpose of the model is to provide the Federal Aviation Administration with an effective procedure to rapidly and reliably determine the economic impact on the U.S airline industry of an aircraft sound suppression retrofit program under a wide variety of reasonable assumptions and alternatives. The model is capable of handling 20 airlines, 15 aircraft types and 20 years. The major computational areas of the model are: airline traffic, revenue, investment base, direct operating expenses, retrofit kit cost, change in direct operating cost due to retrofit, required capital and change in investment base due to retrofit, critical route revenue loss due to retrofit, indirect operating costs, airline rate of return on investment and fare elasticity of traffic demand. Twelve sample cases have been run to demonstrate the model's utility. The cases consist of changes in retrofit kit design, government policy and the types of aircraft covered. Author

N73-11989*# Old Dominion Univ. Research Foundation, Norfolk, Va.
THE MOTION COMMOTION: HUMAN FACTORS IN TRANSPORTATION
Albert E. Millar, Jr., ed., Richard L. Rosen, ed., J. Darrell Gibson, ed., and Ralph G. Crum, ed. 1972 244 p refs Sponsored in part by ASME Original contains color illustrations
(Grant NGT-47-003-028)
(NASA-CR-129092) Avail: NTIS HC $14.25 CSCL 13F

The program for a systems approach to the problem of incorporating human factors in designing transportation systems is summarized. The importance of the human side of transportation is discussed along with the three major factors related to maintaining a mobile and quality life. These factors are (1) people, as individuals and groups, (2) society as a whole, and (3) the natural environment and man-made environs. The problems and bottlenecks are presented along with approaches to their solutions through systems analysis. Specific recommendations essential to achieving improved mobility within environmental constraints are presented. F.O.S.

N73-11990# National Bureau of Standards, Washington, D.C. Office of Standard Reference Data.
CRITICAL EVALUATION OF DATA IN THE PHYSICAL SCIENCES: A STATUS REPORT ON THE NATIONAL STANDARD REFERENCE DATA SYSTEM, JUNE 1972
Stephen A. Rossmassler, ed. Nov. 1972 80 p refs
(NBS-TN-747) Avail: SOD $1.25 as C13.46:747

The status is reported of the National Standard Reference Data System as of June 1972. Recent activities of the Office of Standard Reference Data are summarized and future plans are indicated. A complete list of data evaluation projects supported by the Office of Standard Reference Data during Fiscal Year 1972 is included; this list also includes projects which received financial support during an earlier fiscal year, and which are still actively involved in some aspect of data compilation and evaluation, or which are still preparing a product for publication. Progress in data processing and in information services is reviewed. A listing of continuing data centers in the United States and a list of publications resulting from the standard reference data program are included. Author

N73-11991# National Bureau of Standards, Washington, D.C. Patent Advisers Office.
DISCLOSURE ON: NEW SYNTHESES OF PERFLUOROSTYRENE AND OTHER HIGHLY FLUORINATED DERIVATIVES; TEMPERATURE, RADIATION, AND VACUUM-RESISTANT MAGNETIC TAPE; CONDUCTOMETRIC TITRATION CELL; MILL WORK POSITIONER; PROCESS FOR FABRICATING SUPERCONDUCTING MICROBRIDGES; APPARATUS FOR DISPLAYING AVERAGE WIND VANE OR OTHER SHAFT POSITION; AND DOCUMENT NUMBERING MACHINE RESPONSIVE TO A STAPLE IN A PRINT AREA FOR PRINTING IN AN ALTERNATE AREA
David Robbins and Alvin J. Englert Nov. 1972 32 p
(NBS-TN-744) Avail: SOD $0.55 as C13.46:744

Seven developments that are believed to embody interesting and unusual solutions to current problems in their fields are described and illustrated. Author

N73-11992# European Space Research Organization, Paris (France).
LIST OF REPORTS PUBLISHED BY ESRO
Jun. 1972 49 p refs
(ESRO-SP-88) Avail: NTIS HC $4.50

Scientific and technical reports published by ESRO up to the end of July 1972 are listed. Most of the reports were written by ESRO staff, visiting scientists or contractors participating in the ESRO space program. Arranged in report number order, author and subject indexes are included. Author (ESRO)

N73-11993# Office of Naval Research, London (England).
EUROPEAN SCIENTIFIC NOTES, VOLUME 26, NO. 4
Seymour L. Hess, ed. and Victoria S. Hewitson, ed. 28 Apr. 1972 35 p refs
(AD-742336; ONRL-26-4; ESN-26-4) Avail: NTIS CSCL 06/3

The report is a monthly publication presenting brief articles concerning recent developments in European scientific research. It is hoped that these articles (which do not constitute part of the scientific literature) may prove of value to American scientists by disclosing interesting information well in advance of the usual scientific publications. Author (GRA)

N73-11994# Office of Naval Research, London (England).
EUROPEAN SCIENTIFIC NOTES, VOLUME 26, NO. 5
Seymour L. Hess, ed. and Victoria S. Hewitson, ed. 31 May 1972 31 p refs
(AD-743929; ONRL-26-5; ESN-26-5) Avail: NTIS CSCL 14/2

Contents: Aerospace; Biological sciences; Earth sciences; Education; Engineering; Mathematical sciences; Ocean science and technology; Physical sciences. GRA

N73-11995# Stanford Research Inst., Menlo Park, Calif. Strategic Studies Center.

A DESCRIPTION OF PROGRAM OPSTRAS

Barbara J. Ripple 30 Sep. 1971 30 p refs

(Contract DAHC19-71-C-0001; SRI Proj. 8974)

(AD-746263; SSC-TN-8974-36; SED-TN-518) Avail: NTIS CSCL 15/3

OPSTRAS provides an optimum mixed offense weapons allocation against given overlapping subtractive area defenses in the sense that damage is maximized over the whole multivalued target set. Local defenses can also be included.

Author (GRA)

N73-11996# Office of Naval Research, London (England).

EUROPEAN SCIENTIFIC NOTES, VOLUME 26, NUMBER 7

John M. Leonard and Victoria Hewitson 31 Jul. 1972 30 p refs

(AD-746879) Avail: NTIS CSCL 05/2

The monthly report contains articles-relative to aerospace technology, biological science advancements, structural engineering, computer sciences, physical sciences and microwave technology.

GRA

N73-11997# Army Research and Development Information Systems Office, Arlington, Va.

POINTS OF CONTACT: SCIENTIFIC AND TECHNICAL INFORMATION Annual Report

Robert E. Lazzell Jul. 1972 57 p

(AD-746615) Avail: NTIS CSCL 05/2

The directory identifies individuals who are initial points of contact for research and development information, restricted almost entirely to U. S. Government agencies, with emphasis on Department of Defense agencies. It consists of four parts: Organizational points of contact, within department agencies and commands; Glossary of acronyms; Personnel name index, listing alphabetically the names of persons and page Nos; Subject/title index listing alphabetically subject keywords, titles and their entry number.

Author (GRA)

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC

NASA deposits its technical documents and bibliographic tools in eleven special regional libraries located in the organizations listed below. Each library is prepared to furnish the public such services as reference assistance, interlibrary loans, photocopy service, and assistance in obtaining copies of NASA documents for retention:

CALIFORNIA
University of California, Berkeley
COLORADO
University of Colorado, Boulder
DISTRICT OF COLUMBIA
Library of Congress
GEORGIA
Georgia Institute of Technology, Atlanta
ILLINOIS
The John Crerar Library, Chicago
MASSACHUSETTS
Massachusetts Institute of Technology, Cambridge
MISSOURI
Linda Hall Library, Kansas City
NEW YORK
Columbia University, New York
PENNSYLVANIA
Carnegie Library of Pittsburgh
WASHINGTON
University of Washington, Seattle

NASA publications (those indicated by an "*" following the accession number) are also received by the following public and free libraries:

CALIFORNIA
Los Angeles Public Library
San Diego Public Library
COLORADO
Denver Public Library
CONNECTICUT
Hartford Public Library
MARYLAND
Enoch Pratt Free Library, Baltimore
MASSACHUSETTS
Boston Public Library
MICHIGAN
Detroit Public Library
MINNESOTA
Minneapolis Public Library
MISSOURI
Kansas City Public Library
St. Louis Public Library
NEW JERSEY
Trenton Public Library
NEW YORK
Brooklyn Public Library
Buffalo and Erie County Public Library
Rochester Public Library
New York Public Library
OHIO
Akron Public Library
Cincinnati Public Library
Cleveland Public Library
Dayton Public Library
Toledo Public Library
OKLAHOMA
Oklahoma County Libraries, Oklahoma City
TENNESSEE
Memphis Public Library
TEXAS
Dallas Public Library
Fort Worth Public Library
WASHINGTON
Seattle Public Library
WISCONSIN
Milwaukee Public Library

An extensive collection of NASA and NASA-sponsored documents and aerospace publications available to the public for reference purposes is maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 750 Third Avenue, New York, New York 10017.

EUROPEAN

An extensive collection of NASA and NASA-sponsored publications is maintained by the National Lending Library for Science and Technology, Boston Spa, Yorkshire, England. By virtue of arrangements other than with NASA, the National Lending Library also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy or microfiche of NASA and NASA-sponsored documents, those identified by both the symbols "#" and "*", from: ESRO/ELDO Space Documentation Service, European Space Research Organization, 114, av. Charles de Gaulle, 92-Neuilly-sur-Seine, France.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D.C. 20546

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE $300

FIRST CLASS MAIL

POSTAGE AND FEES PAID
NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
451

U.S.MA

026 3 STAR 730112 S01733HU
UNIV OF MICHIGAN
GENERAL LIBRARY
SERIALS & DOCUMENT SECTION
ANN ARBOR MI 48104

POSTMASTER : If Undeliverable (Section 1
Postal Manual) Do Not Ret

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons. Also includes conference proceedings with either limited or unlimited distribution.

CONTRACTOR REPORTS: Scientific and technical information generated under a NASA contract or grant and considered an important contribution to existing knowledge.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities. Publications include final reports of major projects, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

TECHNOLOGY UTILIZATION PUBLICATIONS: Information on technology used by NASA that may be of particular interest in commercial and other non-aerospace applications. Publications include Tech Briefs, Technology Utilization Reports and Technology Surveys.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION OFFICE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546